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**PREVALENCE AND DETERMINANTS OF MALNUTRITION AMONG  
PUBLIC PRIMARY SCHOOL  
CHILDREN 6-14YRS IN BOR TOWN, REPUBLIC OF SOUTH SUDAN**

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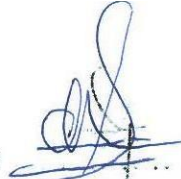
REG No. H58/6706/2017

**A THESIS SUBMITTED IN PART FULFILLMENT FOR THE AWARD OF  
THE DEGREE OF MASTER OF MEDICINE (PEDIATRICS AND CHILD  
HEALTH), UNIVERSITY OF NAIROBI**

November 2021

## **DECLARATION**

I declare that this thesis is my original work and has not to the best of my knowledge been presented to any another university for the award degree.

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This dissertation proposal has been submitted with our full approval as supervisors

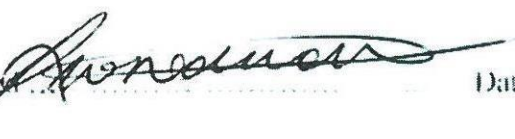
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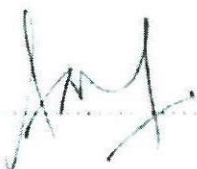
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## **ACKNOWLEDGMENTS**

This thesis would not have been possible without the support of many individuals.

Many thanks to my and supervisors, Professor Ruth Nduati and Dr. Laving for your support and guidance during the course of this work. You have consistently read my revisions and imparted in me the principle of research for present and future work.

Special thanks to chairperson, department of pediatrics and child health, professor Dalton Wamalwa for granting me an extra time during the data collection period.

Appreciation to my parents Gen. Mabil Awar Yuot and Mrs. Amuor Mading Alier without the inspiration and support you gave; I might not be the person I am today.

To my loving husband Isaiah Kuot Malith, my father-in-law, late Gen. Kuol Malith Reech and my adorable children, you are my inspiration and source of love and encouragement. Thank you all for being incredible. I feel grateful to have you as my family.

I would like to thank the ministry of health, South Sudan and the ministry of general Education, Jonglei state for acknowledging the importance of my study in improving the health services.

Glory to almighty God for allowing me to finish this work.

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## LIST OF ABBREVIATION

BMI	Body Mass Index
DALY	Disability Adjusted life Year
HAZ	Height for Age Z score
IQ	Intelligent Quotient
KNH	Kenyatta national hospital
LBW	Low Birth Weight
MDG	Millennium Development Goal
MOH	Ministry of Health
RSS	Republic of South Sudan
SAC	School Aged Children
SCN	Standing committee on nutrition
SD	Standard deviation
SDG	Sustainable Development Goal
SES	Socio Economic Status
SSA	Sub Saharan Africa
UNICEF	United Nations International Children Emergency Fund.
WAZ	Weight for Age Z score
WB	World Bank
WHO	World Health Organization
WHZ	Weight for height Z score.

## **OPERATIONAL DEFINITIONS**

**Stunting;** refers to low length or height for expected length or height of a child of same age of less than -2SD

**Wasting;** refers to low weight for expected weight of a child of the same height of less than -2SD

**Under-weight;** refers to low weight for expected weight of a child of the same age of less than -2SD

**Z-SCORE (or SD score);** It is defined as the deviation of an individual's value from the median value of a reference population divided by the standard deviation of the reference population.

**MUAC:** Any child classified as malnourished based on MUAC for age( Z scores < or equal to -2SD) as validated by Mramba et al.(2017)

**Malnutrition:** Any child classified as malnourished based on MUAC measures.



## ABSTRACT

### **Background:**

In developing countries particularly in sub-Saharan Africa and south Asia, child malnutrition continues to be a public health concern and main contributor to the global burden of disease. School-aged children continue to be a neglected category and rarely involved in nutritional assessment despite the effect of malnutrition on their cognitive and physical abilities. Levels of undernutrition are high in areas affected by hunger and conflicts. The known prevalence of malnutrition in South Sudan based on a study conducted in Akuak Rak region in 2012 was 73% which is quite high. This highlights the need to understand the current prevalence, nutritional status and determinants of malnutrition among primary school children in other parts of the country.

**Objectives:** To determine the prevalence of acute malnutrition as measured using mid-upper arm circumference of school children aged six to fourteen years in Bor town and further describe nutritional status using anthropometric measures (the WAZ, WHZ-and HAZ scores) and estimate the risk factor associated with malnutrition among these age group.

**Methods:** Study utilized cross-sectional design. Stratified multi-stage random sampling technique used to sample 303 students in four public primary schools in Bor Town. A semi-structured questionnaire was used in data collection. The data analysis included both descriptive and inferential analysis. Prevalence of malnutrition was measured using the Mid Upper Arm Circumference (MUAC) while (-2SD Z score cut off for WAZ, WHZ-and HAZ was used in assessing nutritional status. The WHO 2007 ANTHROPAC software were used to aid in the conversion of age, height and weight of the respondents based on weight for age, weight for height and height for age which represent different measurements of underweight, stunting and wasting. Statistical Package for Social Sciences (SPSS version 25) was used in Data analysis. Level of significance was measured at 0.05.

**Results:** The findings revealed that the prevalence of malnutrition was 44% based on MUAC. Further assessment of nutritional status found that, prevalence of stunting (HAZ), wasting (WHZ) and underweight (WAZ) was 4.5%, 11%, 28.5% respectively. There was significant association between number of people in household ( $p = 0.007$ ), number of children in household ( $p < 0.0001$ ) and the number of children going to school in a household ( $p = 0.01$ ) and malnutrition. The findings also revealed that, level of education, ( $p = 0.036$ ) and employment status of the household head ( $p = 0.040$ ) were significantly associated with malnutrition. Multivariate analysis conducted found that, number of people in household greater than 5 people, number of children in household more than five, Household head education level and unemployed status for household head, were independent predictors of malnutrition among children aged 6 – 14 years.

**Conclusion:** The prevalence of malnutrition in school going children in Bor Town is high which present the need to integrate major approaches. Number of people in household, number of children in household, household head level of education and employment status present essential concepts which predict malnutrition in children between 6 – 14 years. Increasing nutritious supplements and quantity of food donations as well as encourage home based farming would be essential in controlling the rate of malnutrition.

## CHAPTER 1: INTRODUCTION

### 1. Background

The World Health Organization (WHO) defines malnutrition as inadequate, excess, or irregular intake of calories or micronutrient deficiencies. It includes both undernutrition and over-nutrition (1). Childhood malnutrition remains a major health issue in low and middle income countries leading to increased disease burden (2). The prevalence of malnutrition in the under-five age group has remained the focus for years. In 2002 the UN Standing Committee on Nutrition (SCN) began to promote researches and intervention plans to the category of school-aged children because this particular age group potentially experience “catch up growth” (3). Unfortunately, the Sustainable Developmental Goals (SDGs), which have replaced the Millennium Development Goals (MDGs) have insufficient focus on school children aged 5-14 years and as a result there is inadequately engagement in the development of among other better nutrition interventions to manage their needs. This sub-population is rarely involved in nutritional assessment despite the adverse effects of nutritional deprivation on their mental, physical, and cognitive skills (4).

School-aged children and adolescents in the developing world are increasingly recognized as a high-burden demographic for nutritional deprivation and infectious disease, with adverse consequences for their developmental trajectory into adulthood. Malnutrition among school-aged children in Africa has been associated with multiple factors which include; morbidity, poor sanitation, food insufficiency, and families with low incomes. In low income countries, undernutrition has contributed to low school enrolment, increased rate of absenteeism as well as early drop out (5). Thus, it is essential to focus on malnutrition as an indicator to provision of basic needs among children. Malnutrition is also a reproduction of inadequate investment and growth involving social capital and negative influence on the future economic development of a nation (6).

Malnutrition is not a simple problem with a single and simple solution. There are different factors that contribute to increased prevalence of malnutrition in children (7). The most immediate determinants are inadequate dietary intake and disease which are themselves caused

by a set of underlying factors: household food insecurity, poor maternal/child caring practices, and lack of access to basic health services including lack of safe water supply and unhealthy living environment such as open defecation (8). In turn, these underlying causes themselves are influenced by economic, political, and sociocultural conditions; national and global contexts; capacity, resources, environmental conditions, and governance (9).

The Republic of South Sudan gained independence recently in July 2011 after a long period of internal conflicts. The country was born in crisis following decades of civil war, and continues to be characterized by a highly volatile political, economic and humanitarian situation (10). In this unstable, war-ravaged context, the burden of infectious diseases, food insecurity and child malnutrition are known to be elevated. Although there exists programmatic data reported from humanitarian organizations, published reports on child and youth nutrition and health from the region are scarce. In a recent study conducted in South Sudan, the prevalence of malnutrition was 73% (11).

The Government of South Sudan is investing in basic education programs. Primary schools provide an opportunity for addressing prevalent health issues to optimize learning and lay foundation for health adulthood. Given the very high prevalence of malnutrition, school nutrition programs would be a key way to mitigate against this high prevalence of malnutrition. A baseline assessment of nutrition status of children currently enrolled in primary school, would provide additional information on whether a school feeding program is a reasonable option for mitigating against malnutrition (10). In an environment where universal enrollment is not the norm, it is possible that school attending children are reasonably healthy and the extremely high figure of malnutrition is being contributed by out-of-school children.

Malnutrition a major challenge in low income countries is often explained away as poverty and in regions ravaged by conflict like the South Sudan, childhood malnutrition is fait accompli; a wait and see approach, and limited effort to improve on the poor feeding programs or development of a sustainable system for strong level of feeding. A recent study from Syria challenges this status quo, a cross sectional study recently conducted among Syrian refugees in Iraq, and Jordan, found the prevalence of acute malnutrition among children aged 6 to 59



months was less than 5%. The findings highlight that nutritional partners in the region have effectively focused on reprioritizing response interventions which focus on addressing the existing micronutrient deficiencies such as food fortification (12). Lack of focus on the basic aspects of human life have created a major gap that should be exploited and help create a more diverse context in building a strong change development. This study only addresses a small piece of this puzzle, the nutritional status of children enrolled into public school in the town of Bor, a town bordering the White Nile. This study provides planning data for the local communities, as well as the health and education departments.

## CHAPTER 2: LITERATURE REVIEW

### 1. Epidemiology

#### 1.1. Global

In 2019 the United Nations International Children's emergency funds, world Health Organization, World Bank joint committee on child malnutrition estimated that 149 million under five children are stunted, 49 million are wasted whereas 40 million are overweight and these estimates mainly constitute Sub-Saharan Africa and South Central Asia (13). Sub-Saharan Africa is greatly affected because of high levels of poverty and regular ethnic classes which are caused by limited resources and poor governance. The over-reliance on donor funds to help solve malnutrition crisis in most of these countries have created a huge gap that in resource mobilization among respective countries.

Malnutrition is defined by the state of an individual being obese, underweight, stunting or wasting. Different regions have shown different levels of malnutrition. Globally, approximately 60 million people are affected with moderate malnutrition while 13 million children are affected with acute malnutrition. The global reports show that approximately 22% of children are stunted, 13.4% are underweight while 7.3% are wasted (14). The WHO also estimates that about 5.4 million under-five children die each year among them 2.7 million deaths in Sub-Saharan African (SSA) countries (15). There are regional variations in the spectrum of malnutrition among school age children. Developed countries have different nutritional challenges as compared to low income settings. In high income countries, obesity has emerged as the major nutrition challenge. A cross sectional study conducted in Galician, Spain among school going children aged 6 and 15 years, found obesity in 15% of the respondents, 0.7% were underweight while short stature was estimated at around 1%. A higher prevalence of underweight was found in females compared to males (16). However, the findings from the study show different demographics compared to developing countries and those having conflicts such a South Sudan.

## **1.2. Regionally**

A study conducted in 32 SSA countries found high numbers of chronically malnourished children. More than a third of the children had stunting in seven countries, highest in Burundi at 57%, Malawi 47%, Niger 44%, Mali 38%, Sierra Leone 38%, Niger 37% and DRC with 42% stunting. Three countries had extremely high wasting rates, among them Niger 18%, Burkina Faso 15%, and 9% in Ethiopia. Underweight was highest in Burundi at 29%, and Ethiopia 25% (17). Resource management has been a major challenge in Sub-Saharan Africa, creating the existing challenge in malnutrition among children. More than half of the Sub-Saharan Africa live below poverty line making it difficult for them to overcome these malnutrition challenge on their own.

Localized studies replicate the findings of the large regional studies. A study conducted in Egypt rural setting of Fayoum Govern orate found the prevalence of stunting to be 34%, underweight 3.4%, wasting at 0.9% and obesity in 15% of the sample respondents. In this study, increasing age, reduced poultry consumption and escaping breakfast were associated with stunted growth. The high rate of malnutrition within in the region was in concordance with the national prevalence (18). The researchers concluded that malnutrition in the region was caused by unbalanced diet consumed by the local population as well as high levels of rural poverty. There were similar findings in the neighboring nation of Sudan. In a similar study conducted in the Alrawakeeb valley in Sudan, the prevalence of severely malnourished children was 28% and 35% have mild or moderate malnutrition (19). There is an urgent need to intervene if children are to achieve optimal health into adulthood. Children are enrolled in primary school for 7-8 years. Nutrition interventions in this age group have the potential of changing the trajectory of their lives through the improved nutrition status and therefore better cognition and ability to learn. The financial expenditure on school feeding programs is substantive and the gains being largely long-term manifest as improved or conserved human capita. These lofty benefits are hard to measure in the short term. On the other hand, studies to quantify magnitude of malnutrition among school age children provide a justification for this type of investment and can be the basis of short-term monitoring of the impact of these programs.

### **1.3. Locally**

The prevalence of malnutrition in East African region remains high based on the high levels of poverty, high rates of unemployment and limited development initiatives that are aimed at improving the lives of citizens. A community based cross sectional study conducted in Ethiopia revealed that the prevalence of wasting was 16.2%, stunting was 43% while underweight prevalence was 25% (20). The findings from the study also reveal that child malnutrition was high among children between 6 and 15 years. Ndemwa et al (2015) in Kwale county, on the South Coast region of Kenya found prevalence of malnutrition to be 29.2% stunted, 20.8% underweight of whom around 10% were severely underweight. Male children had significantly prevalence of stunting, 35% compared to 22% (21). In another study in Kilifi, the North Coast region of Kenya, the prevalence of malnutrition among school children was estimated to be 27.5%, stunting was more commonest at 16.6% whereas wasting and underweight accounted for 2.7% and 8.3% respectively (2). Kilifi is a poor resource setting and characterized by high poverty index which is likely to have an influence on the high prevalence of malnutrition.

### **1.4. Malnutrition in South Sudan**

In 2017 the United Nation International Children Fund reported that almost 1.1 million children in South Sudan are acutely malnourished out of these 280,000 children are severely acutely malnourished. In the 2019 UNICEF division of data research and policy estimated that among the under-five children 48.6% were well nourished, 21.3% stunted, 17.6% wasted, 2.5% overweight, 6.7% both stunted and wasted and 3.3% stunted and overweight but no data on nutritional status among school aged children (13). A more recent cross sectional study conducted in South Sudan, found that 73% of children were underweight (11). This latter study focused on assessing malnutrition and malaria among school age children and adolescents. The study was performed in a region with high malaria prevalence and therefore may not be representative of other regions in South Sudan. The study did not assess the different categories of malnutrition hence difficult to make a recommendation regarding the best approach to be considered in controlling malnutrition. This study thus aimed at providing a more understanding on the magnitude of malnutrition as well as associated risk factors in Bor Town. There is no official South Sudan Government data on nutrition status of children aged 6-17 yrs.

## **2. Determinants of malnutrition among primary school children**

Vulnerability of malnutrition is high in children mainly due to low dietary intake, unequal distribution of food in both schools and households (22). The economic implication of under-nutrition is significance hence requires integration of different approaches to help in controlling the situation. World Health Organization identifies that underweight is the most critical risk factor in development of global burden of disease across developing countries. Under-nutrition lead to around 15% in the total Disability -Adjusted Life Years (DALY) loss especially in countries that have higher child mortality (23). Childhood stunting has contributed to a 1% loss in adult height that is linked to around 1.4% loss in productivity (24). Therefore, controlling childhood stunting is associated with increased productivity in adulthood which is essential in improving positive health.

### **2.1. Maternal factors**

A research done in Nepal showed that there was an association between child malnutrition in school and maternal literacy, occupation, dietary knowledge, and monthly income of the mother (25). Similar study conducted in Kenya revealed that the major independent risk factors for malnutrition among children were household food insecurity and source of income of the household head (26). Education level of the household head has also been identified as a predictor of malnutrition in children. High literacy level means that an individual is able to understand components of a balanced diet. Employment allows individuals to afford basic needs which include food hence having the ability to improve nutritional status of their children.

### **2.2. Infection**

Infection is a vital risk factor for malnutrition. It has a significant impact on child growth. Chronic Diarrheal diseases have been linked to wasting (2). Malnutrition has been a primary cause of immunodeficiency globally. Malnutrition underlies 50% of all childhood deaths. Poor feeding during repeated infection and failure to institute adequate feeding in the recovery phase leads to malnutrition. Malnutrition in turn impairs immunity predisposing the child to repeated episodes of illness, thus forming a vicious cycle of infection and malnutrition. Malnutrition

deficiencies have also been associated with negative outcomes including poor growth, high susceptibility to infection as well as impaired intelligence (27).

### **2.3. Household characteristic**

Household form a fundamental aspect in defining child development in terms of nutritional care. Household heads play a major role in maintaining a greater wellbeing among their dependents. A recent cross sectional study done in Kenya revealed that lack of a father figure contributes directly to the health of the child while increase in mother's education was associated with high level of wasting among school children despite their involvement in feeding program initiated in school. The number of household members was associated with stunting and wasting. However the study revealed that participation in the feeding program was not associated with malnutrition hence malnutrition is influenced by other factors other than the feeding program that was enrolled in school (4).

### **2.4. Feeding programs**

Feeding programs in schools especially in conflict and areas experiencing adverse climate have been essential in improving the wellbeing of students. However, the feeding program was associated with positive outcomes such as reduced anemia, malnutrition as well as child growth (28). In a similar study conducted in Madagascar among school children aged between 5 and 14 years undergoing a feeding program, the findings revealed that older children were more likely to be stunted and thin.

### **2.5. Socio-demographic factors**

The older age group among school-age children was an independent determinant of stunting. Children within 10 -14 years age group were more likely to become stunted. The results from the study identified that mothers who completed primary school education were less likely to have stunted children (29). Having a larger family size, inadequate intake of carbohydrates were independent factors that predict wasting. Household food security was an independent predictor of malnutrition. Older age, living in urban areas and low social economic status, low income neighborhood were associated to a lower HFA z-score while those in rural areas and have low socio economic status were associated were associate with lower BMI for age z-

score (30). Similarly, a cross sectional study conducted on Ghana showed that the factors that were associated with stunting include the type of the community, areas of residence, gender, age and the sub-district of the pupil (8).

### **3. Indicators of Nutritional status**

Growth and development of children is defined by adequate nutrition (20). There are different definitions for malnutrition based on region and the underlying status. However, in this case, malnutrition is defined as a pathological state that occurs as a result of deficiency of essential nutrients for growth (20). Wasting and stunting are associated with severe and chronic exposure for malnutrition respectively while underweight involve both acute and chronic exposure for malnutrition (18).

#### **3.1. Underweight**

World Health Organization highlights that, underweight individuals is measured taking into consideration weight for age which is alternatively -2 standard deviations of the WHO Child growth Standards median (31). Research shows that there is an increased mortality risk for children who are mild underweight while severely underweight are even at an extremely high risk. In situations of chronic malnutrition, weight for age is a composite measure of stunting and wasting, and is not the best estimate of current nutrition status in older children. Accuracy of weight for age measurements is based on relatively acute estimates of the age, which is a challenge in regions where vital statics are not routinely documented. Nevertheless, different researchers have conducted studies assessing underweight in children (10, 15, 18).

Developing countries are significantly affected by undernutrition among school going children with evidence showing that approximately 52% of school age children are malnourished and if no major interventions are put in place, there is a likelihood of more than one billion children becoming mentally and physically impaired(27,28). The prevalence of underweight has been a major malnutrition challenge among many school going children in Africa. According to a survey study conducted in South Africa including children between 10 and 12 years which identified that 66% of the respondents were underweight while 28% of them were normal (32). In a study done in Ethiopia, around 15.9% of schools going children were underweight. The

study similarly indicated that the chance of being undernutrition among school age children was dependent on the age of the mother where mothers within 20 to 30 years were less likely to have underweight children (29). In a study conducted in Eastern Cape Province in South Africa among primary school learners assessing malnutrition in 9 to 14-year students, the results revealed that 61.8% of the students were underweight with only 32% of the students being normal. The higher number of underweight learners was in rural areas. The rate of underweight was higher in boys than girls. The higher rate of underweight is not unique to this region. a study done in India including a population of 6 to 10 years, 54% were underweight and among them boys were more affected(33). The higher prevalence of underweight present the need to make better decisions regarding the interventions to the current state (34).

Studies have shown that approximately 52.5% of the deaths among young children in SSA are attributed to underweight. It is also identified that underweight children are 8 times more likely to die than normal children (11). (33).

### **3.2. Stunting**

Stunting is based on a measure of height for age and is the nutrition measure most closely associated with cognitive function. The accuracy of measurement is affected by accuracy of age estimates especially in the younger child. Manifestation of malnutrition in early childhood is mainly shown based on the development of stunted growth. approximately 36% of stunted children globally are in Africa with 27% in Asia (3). Controlling the development of stunted growth includes emphasis on good nutrition during pregnancy and the first two years of child development. Stunted growth in children is not only associated with physical appearance but also with stunted development of the brain and cognitive wellbeing (7). A recent study in Kenya, Kibera slums showed that children who participated in school feeding program were less stunted and wasted. In another study conducted in Pakistan among SAC between 5-12 years, found 8% of the children who were investigated were stunted. The results also identified that stunting and wasting were significantly associated with gender with boys being more affected than girls (30).



### **3.3. Wasting**

Wasting is an indicator of acute malnutrition. Left mid-upper arm circumference measurement is the most sensitive measure of wasting. The other measure is weight for height. Both measures are not dependent on accurate measures of age. Wasting is the measure of nutrition status that best predicts death. Case fatalities of common childhood illnesses are higher in children with more severe malnutrition. Wasting is an increasing malnutrition issue among children especially school going children. The findings obtained from a study in Madagascar among school-age children identified that 11% of them were wasting while 5% of the respondents were underweight, stunted and wasted (4). In another study cross-sectional study conducted in Western Nepal, the finding showed that 12% of the primary school learners were found to be wasted while only 1% were found to be both stunted and wasted (25). Similar study done in Ghana identified the prevalence of wasting was found to be 9.6% in schools without feeding program and 4.6% in schools with feeding program (8).

### **3.4. Mid-Upper Circumference (MUAC) Measurement**

The Mid-Upper arm circumference provides a better and reliable tool for screening nutritional status in large populations. It has been greatly used to measure undernutrition and severe acute malnutrition among infants, children and expectant mothers. However, studies have shown that MUAC varies with height for age z score (HAZ) (23,25). However, despite MUAC being found to be a good predictor of malnutrition in infants and children, there have no universally established age and sex specific MUAC cutoff for identification of undernutrition in children over five years. A study conducted in Sri Lankan School age children investigating the efficacy of Mid-Upper Arm circumference in predicting malnutrition found that MUAC was a good predictor with cut off values for thinness at 167.5mm and 162.5mm for stunting. However, these cut-offs differed based on age stratification (35).

## **4. Consequences of Malnutrition in school-aged children**

### **4.1. Physical and cognitive development**

Child malnutrition is associated with different physical and cognitive factors including delayed physical growth, lower intellectual level, deficient social skills as well as vulnerability in

disease development (16). Malnutrition has also been linked to increased risk of chronic illness among children (23). In a study done in Kenya, it was identified that school aged children do not experience catch up growth although they are more likely to develop increased height deficits with age within a given environment (6).

## **5. Study Justification**

Poverty levels have remained high as a result of conflicts and natural disasters such as drought in many developing countries. Most of these countries do not have clear and poor planning on food security which have been necessitated by lack of good governance. More than 60 million children go to school hungry every day globally with 40% of them from the African continent (2). The prevalence of malnutrition in under-five age groups has remained the focus for years, although in 2002, the UN -SCN began to promote researches and intervention plans to the category of school age children (SAC) because this particular age group potentially experience “catch up growth” (3). In the 2019 UNICEF division of data research and policy focused on under-five children in South Sudan.

Youngsters under the age of five have gotten more attention than school-aged children when it comes to nutrition. Malnutrition can be avoided in this population. Children can catch up in development if their environment improves (13) Early intervention would so improve general development, resulting in more active adults and, ultimately, economic prosperity. This study provides essential information on nutritional status among SAC in Bor town, South Sudan. This lay a foundation for further studies about the malnutrition in other parts of the country. This assist in early identification on whom at risk of malnutrition and put interventions plans to improve the nutritional levels of school going children in Bor town and the overall economy of the area.

## **6. Research question**

What is the prevalence and risk factors associated with malnutrition among school-aged children in Bor town, South Sudan?

## **7. Study objectives**

### **7.1. Primary objective**

To determine the prevalence of malnutrition (wasting, stunting and underweight) among school aged children (6 – 14 years) in public Schools in Bor Town.

### **7.2. Secondary objectives**

1. To evaluate the socio-demographic factors associated with poor nutritional status among school age children 6- 14 years in public school in Bor Town.

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## CHAPTER 3: RESEARCH METHODOLOGY

### 1. Study Design

The study utilized cross sectional research design to identify the nutritional status among school age children in Bor Town. Cross-sectional nutritional surveys are a standard approach to monitoring effect of natural and man-made disasters or interventions on nutrition status of the population.

### 2. Study Area

The study was conducted in public primary schools in Bor town of Jonglei state located at 200 km northern east of Juba, the capital of South Sudan. The total population of Bor town was estimated to 61,716 as projected from the 5<sup>th</sup> Sudan population and housing census 2010. The town has 12 public primary schools. The main activities in Bor town are include fishing, cattle keeping and farming. The town is on the banks of the White Nile and therefore has potential for adequate food security.

	
Aerial view of Bor Town, South Sudan	Children playing on the banks of White Nile in Bor Town

### 3. Study population

The study included primary school children attending public primary school in Bor Town aged of 6 and 14 years. Bor Town has 12 public primary schools that were targeted in this study. Public schools have been considered in this case because they provide a clear representation of the general lifestyle within the community.

#### **4. Inclusion criteria**

- ❖ Public primary school children aged between 6 – 14 years.
- ❖ Children for whom informed written consent was obtained from the headteachers to participate in the study.

#### **5. Exclusion criteria.**

- ❖ All private primary school children.
- ❖ Children with obvious physical deformities – [nutrition status was assessed not be included in the analysis of prevalence of malnutrition].
- ❖ Children for whom there is no consent obtained.

#### **6. Study variables**

##### **Independent variables**

- Age
- Weight
- Height
- Gender
- Left Mid -upper arm circumference Left MUAC
- Current class
- History of repeating a class
- Number of siblings
- Who is the guardian?

##### **Dependent /Outcome**

- Nutritional status.
- Weight for age
- Height for age
- Weight for height
- MUAC

## 7. Sampling and sample Size determination

### 7.1. Sampling

The study used multi-stage random sampling strategy to identify study participants in schools within Bor Town. Bor Town has four regions namely Marol, Malou, Langbar and Hai Machor.

The distribution of schools in these regions is as shown in the Table 1

Region	Schools	No. of pupils
Marol Region	Bor A	700
	Bor B	700
	Bor girls	700
	St. Andrew	350
Malou Region	Malou primary	700
	Tueng Gau	600
Langbar	Nile Primary	550
	Gakyuom A	750
	Gakyuom B	700
Hai Machor	Bor Public	800
	Dochoum	600
	Anyedi primary	500

From the four regions, one school was selected randomly by use of lottery method. The numbers were well mixed before the sample was selected. Based on this method the four schools that were randomly sampled re illustrated in the table 2

Region	Schools	No. of pupils
Marol Region	Bor girls	700
Malou Region	Malou primary	700
Langbar	Nile Primary	550

Hai Machor	Bor Public	800
<b>Total</b>		<b>2,750</b>

Once the children who meet the inclusion criteria were selected, they were stratified proportionately based on the sample calculated to ensure randomness of selection. Every second child was selected in each school based on the formula  $K = N/n$ .

## 7.2. Sample size determination

Based on the prior information obtained in a study cross-sectional study conducted in South Sudan, the prevalence of malnutrition was 73%, (11). Fischer's formulae were used. Thus,

$$n = \frac{Z^2 * P(1-P)}{e^2}$$

n is the sample size

Z is the value at 95% confidence interval (1.96)

e is the margin of error ( $\pm 5\%$ )

P is the estimated prevalence (based on a study by Charchuk et al. (2015), the value used is 73%.

$$N = \frac{1.96^2 * 0.73 * 0.27}{0.05^2}$$

The sample size is 303

Therefore, the sample from each proportion was obtained as follows

School	Population of students	Proportionate sample size	Sample population
Bor girls	700	$700/2750 * 303$	77
Malou primary	700	$700/2750 * 303$	77
Nile Primary	550	$550/2750 * 303$	61
Bor Public	800	$800/2750 * 303$	88
<b>Total</b>	<b>2,750</b>		<b>303</b>

## 8. Recruitment flow chart

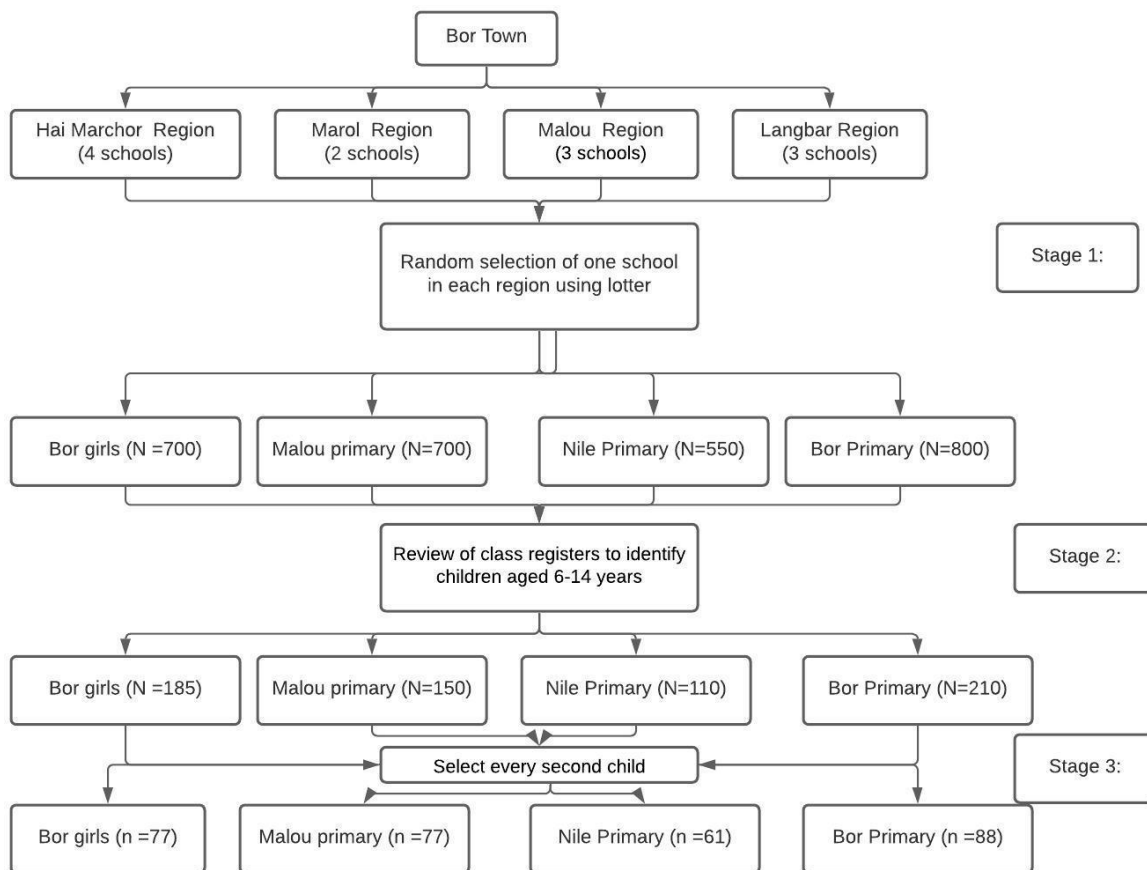


Figure 1: Recruitment of respondent's flow chart

## 9. Research tool

The study used a semi-structured questionnaire. The questionnaire was translated into Dinka language and back to English language to ensure consistency. The questionnaire included socioeconomic and demographic factors.



## **10. Research assistants**

The data collection process included eight research assistants who were, two nutritionists, six public health workers. The focus on nutritionist and public health workers is because they understood the development of malnutrition hence helped in accurately collecting data. The research assistants underwent a 2-day training to understand the data collection tool as well as the selected schools and recruitment process.

## **11. Data Collection Procedure**

The data collection process began after obtaining approval from the ministry of education, RSS and UoN-KNH Ethics review committee. Permission was sought from the school administration to allow access to students and school registry. The researcher used the school registry in all of the four schools selected to help identify students who were aged between 6 and 14 years. Once the total number of students within the age group was identified, proportionate sample of male to female respondents were enrolled in the study. The study then recruited children aged 6-9 years as one cohort and 10-14 years as the other group. The school registry was used to select pupils based on age. The focus on age group rather than class in the recruitment process was based on understanding that majority of classes in South Sudan are not age specific and there is high chance of getting older pupils in lower classes as a result of late enrolment, repeat of class and frequent and recurring conflicts which negatively impact student performance.

Participants into the study were identified using a systematic random sampling in each of the schools. The researcher contacted the parents whose children were selected in the study to seek verbal consent through telephone call. Parent/caregiver details of children aged between 6 and 9 years were obtained from the phone call made while for children between 10 and 14 years, they carried the forms from where their parents filled and the forms were returned. For those who were unable to read, the researcher with the help of research assistants helped through a phone call. This approach was adopted considering that some of the children come from far districts and during the study data collection period, there were floods within Bor region.

School records were used to determine age. Eligible children had their weight, height, measured to the nearest 0.5g and 0.1cm respectively. Mid upper arm circumference measurement was taken. Children were interviewed to obtain socio-demographic characteristics.

## **12. Measurements.**

There are many methods of classifying malnutrition however, in this particular study WHO system (z-scores) was applied because it's the most widely used. Height, weight, age and MUAC measurements were obtained. MUAC for age was measured based on WHO growth standard of MUAC for age z score with cutoff of -2 standard deviations of the Z scores. The MUAC (cm) was measured using colored plastic tape measure. The participant was required to bend the left arm, and their upper midpoint between the tips of the shoulder and the elbow, then wrapped a measuring tape around the marked midpoint and recorded MUAC to the nearest 0.1cm.

The measurement of the respondent body weight was done using a digital portable weighing scale. Respondents were required to wear light clothing which is preferably school uniform with no shoes, jackets or any additional clothing or anything that could increase weight significantly.

The heights for respondents were measured using the portable stadiometer. Respondents were required to wear no shoes while standing in Frankfurt position. The shoulders, buttocks and the heels touched vertical stand. The height measurement was recorded to the nearest 0.1cm.

### **12.1. Nutritional status scoring**

The scoring of the student measurement was done based on focus on age, weight and height as identified in the WHO 2007. The WHO 2007 ANTHROPAC software were used to aid in the conversion of age, height and weight of the respondents based on weight for age, weight for height and height for age which represent different measurements of underweight, stunting and wasting.

Measuring child nutritional status mainly include normal, wasting, stunting, underweight and overweight. The World Health Organization (WHO) provide a different perspective in defining

underweight, stunting and wasting in relation to z-scores. The WHO defines underweight as weight for age, stunting as height for age while wasting as weight for height assessed at -2 standard deviations of the WHO Growth standard media for all of them (31).

### **13. Pre-test**

The study instrument was pre-tested in Langbaar Mixed Primary. Pre-test was used to assess whether the questionnaire captures analyzable respondent data as well as ensure that the processes that have been included in the study are achievable.

### **14. Data Quality Control**

Maintaining quality of data involved converting the Questionnaire developed in English to the local Dinka language so that it would be easy to identify specific factors that are being assessed. The questionnaire from Dinka language was translated back into English to help determine the level of consistency. Three-day training was organized for the research assistants to help in familiarization of the questionnaire, processes involved and the study settings. The principal investigator ensured continuous monitoring of the process on a daily basis.

### **15. Study limitation**

The study focused on school children between 6 and 14 years who might have better parental socio-economic status, those who at home were not captured in the study and therefore they were not screened.

### **16. Ethical Considerations**

Ethical clearance was obtained from Kenyatta national hospital scientific Research and Ethics Committee in collaboration with the ministry of education RSS. The study sought the approval from the University of Nairobi. Letters of permission were obtained from Jonglei state authority. Verbal consent was obtained from the Parent's participant or participant's closest guardian through the school head teacher before the commencement of the study. The aim of the study was fully explained to ensure it was understood by all parties involved before provision of permission or consent.

## **17. Statistical Analysis**

Data collected and stored in questionnaires were entered into a pre-developed epi-data database to ensure it is organized and well collected. The WHO. 2007 3.2.1 software was used to calculate the anthropometric indices.

Descriptive statistics were used to describe respondents' characteristics from the sample population. Among the variables to be used for this included but not limited to; Gender, age, level of education.

Based on the World Health Organization Standards for detecting child nutritional status. The data be exported into SPSS where it was transformed into Z scores so that the cut off of -2SD can be used in grading children nutritional status as either underweight, stunted or wasted. The prevalence of malnutrition was expressed as a proportion in percentage. Undernutrition was calculated based on MUAC as validated in a study conducted in Sri-Lanka among school going children which found that the cut-off of 167.5mm was appropriate (35). Chi -square test for association was used to determine the association between categorical variables included in the study. SPSS version 25 was used to analyze data. The hypothesis was tested at 95% confidence level.

## CHAPTER FOUR: RESULTS

### 1. Introduction

The study sought to investigate nutritional status of children aged between 6 and 14 years in Public schools in Bor Town, South Sudan. The sample size targeted was 303 children in four public schools identified within Bor region. A total of 303 questionnaires were distributed proportionately in all the four schools where 295 questionnaires were completely filled and returned for analysis representing a 97% response rate.

### 2. Demographic characteristics

#### 2.1. Personal Data for children between 6-14 years in Bor Town

##### Distribution of children by age and gender

The findings revealed that majority of the children in the study, 64.7% (n =191) were aged between 10 and 14 years and most of the were male, 58.6% (n =112). In addition, 35.2% (n =104) were aged between 6 and 9 years with more than half of them, 52.9% (n =55) being female as presented in Figure 1.

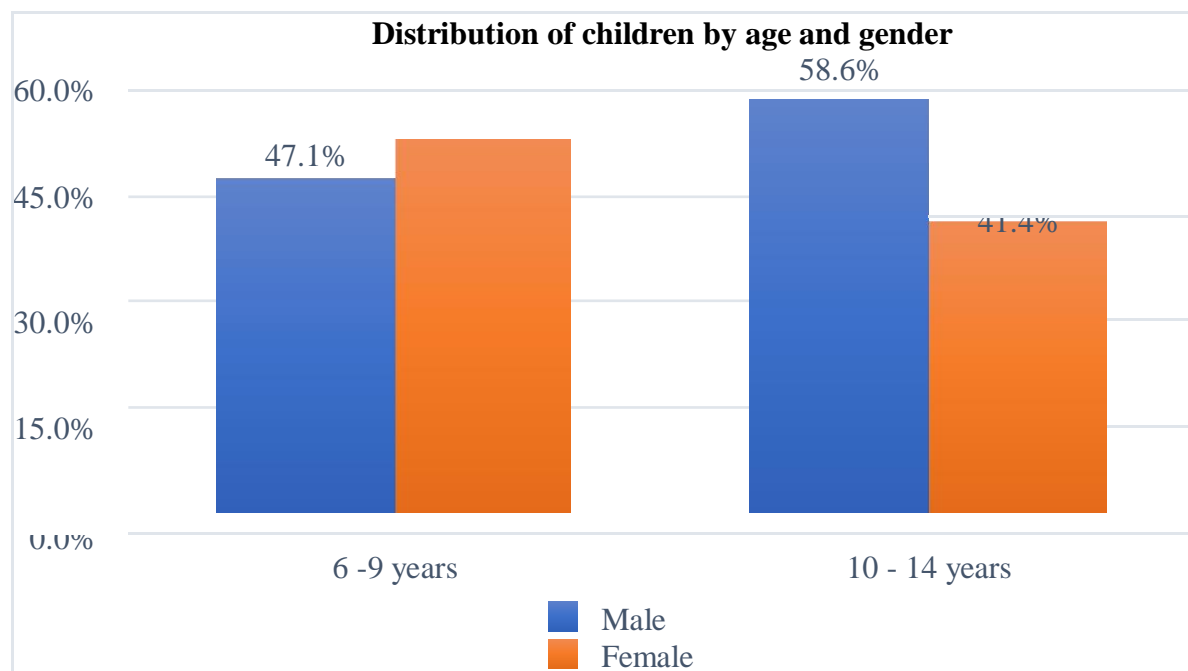


Figure 2: Distribution of children by age and gender

### Present class and history of repeating class

The study also investigated present class and history of repeating class among participants as shown in Table 1. Majority of the children aged between 6 and 9 years, 83.4% (n =85) were in class 1 presently with only three in class 4. Three quarters, 74.9% (n =143) of the children aged 10 to 14 years were in class 4 or below presently with only 16.8% (n =32) in class 8. Most of the respondents, 85.8% (n =253) across all age groups had a history of repeating class, 79.8% (n =202) reported history of repeating class 2.

Table 1: Present class and history of repeating class

		Age of the children		
		6 -9 years	10 - 14 years	Total
<b>Present class</b>	1	85 (83.4)	34(17.9)	118(46.6)
	2	9(8.8)	39(20.5)	48(19.0)
	3	5(4.9)	41(21.6)	46(18.2)
	4	3(2.9)	29(14.3)	32(12.6)
	5	0	11(5.8)	11(4.3)
	6	0	4(2.1)	4(1.6)
	8	0	32(16.8)	32(12.6)
	<b>History of repeating class</b>	Yes	85(81.7)	168(88.0)
No		19(18.3)	23(12)	42(14.2)
<b>Class repeated</b>	1	8(9.4)	37(22.0)	45(17.8)
	2	73(85.9)	129(76.8)	202(79.8)
	3	2(2.4)	2(1.2)	4(1.6)
	6	1(1.2)	0	1(0.4)
	7	1(1.2)	0	1(0.4)

## 2.2. Household head demographic characteristics

The demographic characteristics of the household heads was investigated as shown in Table 2. The average age of the household heads was 43(SD±10) years. All of the households were led by either father, 69.5% (n =205) or mothers, 30.5% (n=90), most of them were married, 79.6% (n=235) and many of them, 60.3% (n =178) did not have any formal education. In investigating employment status, 34.9% (n =103) were unemployed, 31.5% (n =93) were casuals and less than a quarter, 24.4% (n =72) of the household heads were formally employed.

Table 2:Demographic characteristics of household heads

		Frequency (n)	Percentage (%)
Age	Mean (SD)	43(±10)	
Gender	Father	205	69.5
	Mother	90	30.5
Marital status	Single	12	4.1
	Married	235	79.6
	Divorced/separated	7	2.4
	Widowed	41	13.9
Level of education	None	178	60.3
	Primary	59	20.0
	Secondary	40	13.6
	Post-secondary	8	1.7
	Adult education	10	3.4

	Casual	93	31.5
	Self employed	27	9.2
	Unemployed	103	34.9
Employment status	Employed	72	24.4

### 2.3. Household characteristics of the study participants

The household from which the children come from were also assessed as shown in Table 3. The results found that, 46.8% (n =138) of the households, their main source of food was buying and donations received, Half of the households had two meals a day. In assessing number of people per household, majority of the households, 78.6% (n =232) had more than five people in the household. More than half of the households, 53.2%(n =157) had more than five children and 51.2%(n =151) of the households had more than three school going children.

Table 3:Household characteristics of the study participants

		Frequency (n)	Percentage (%)
	Bought and Donated	138	46.8
	Homegrown and bought	77	26.1
Main source of food	Donated	80	27.1
Number of meals at home per day	One	138	46.8
	More than 1	157	53.2
Number of people in household	Less than 5 people	63	21.4
	More than 5 people	232	78.6



Number of children in household	Less than five children	138	46.8
	More than five children	157	53.2
Children in household going to school	Less than 3 children	144	48.2
	Greater than 3 children	151	51.2

#### 2.4. Institutional factors

All of the schools had a feeding program in place, where almost all of the children, 95.6% (n =282) reporting having one meal a day while 4.4% (n =13) reported having more than one meal a day as presented in Figure 2.



Figure 3: Number of meals served at school per day

#### 2.5. Types of food served in the feeding program

Most of the feeding programs implemented in schools were plant based, 95% (n =281) as shown in Figure 3.

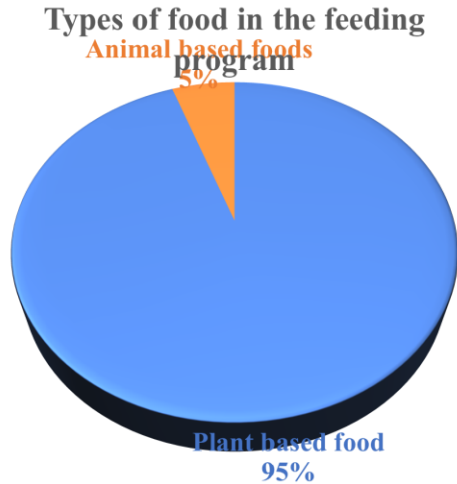


Figure 4: Type of food in the feeding program

### 3. Prevalence of malnutrition among children aged 6-14 yrs. in public schools in Bor town

Malnutrition was assessed using MUAC for age. The findings revealed that 44% (n =130) of the children who participated in the study were malnourished, 95% CI (38.3%, 49.9%).

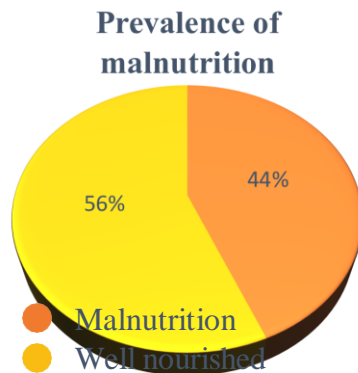


Figure 5: Prevalence of malnutrition

#### 3.1. Malnutrition based on age group

The findings revealed that, Moderate malnutrition was the most prevalent in both groups with 18.3% (n =19) in children between 6 and 9 years and 50.3% (n =96). Severe malnutrition was present in 3.8% (n =4) of children aged 6 -9 years and 5.2% (n =10) in children aged between 10 – 14 years as shown in Table 4.

Table 4: Malnutrition based on age group

		<b>6-9 years</b>	<b>10-14 years</b>	
		Frequency n (%)	Frequency n (%)	Total n (%)
Malnutrition status	Severe malnutrition	4(1.4)	10(3.4)	14(4.7)
	Moderate malnutrition	19(6.4)	96(32.5)	115(39.3)
	Well-nourished	81(27.5)	85(28.8)	166 (56.3)

#### **4. Nutritional status among children aged 6-14 yrs. in public schools in Bor town.**

##### **Underweight**

The findings revealed that, 28.5% (n =84) of the respondents were underweight, 11% (n =32) were wasted while 4.5% (n =14) were stunted as shown in Table 5.

Table 5: Nutritional status among children

<b>Malnutrition status</b>	<b>Total n (%)</b>	<b>6 - 9 years n (%)</b>	<b>10 - 14 years n (%)</b>
<b>Underweight (&lt;-2SD)</b>	84(28.5)	31(10.5)	53(18)
<b>Wasting (&lt;-2SD)</b>	32(11)	11(3.7)	21(7.1)
<b>Stunting (&lt;-2SD)</b>	14 (4.5)	5(1.7)	9(3.05)
<b>Malnutrition (MUAC &lt; 167.5mm)</b>	130(44)	47(15.9)	83(28.1)

## **5. Socio-demographic factors associated with poor nutritional status among these school-aged children in Bor town**

### **5.1. Association between household characteristics and nutritional status**

A Fisher's test for exactness was conducted to determine the association between household characteristics and nutritional status as showed in Table 6. The results found that there was significant association between number of people in household ( $p = 0.007$ ), number of children in household ( $p < 0.0001$ ) and the number of children going to school in a household ( $p = 0.01$ ) and malnutrition.

Children from a household of more than 5 people were 2.3 times more likely to be malnourished compared to those coming from a household with less than 5 people, OR = 2.293, 95%CI (1.253, 4.197). Children from a household with more than five children were 2.7 times more likely to be malnourished compared to those from household of less than five children, OR = 2.676, 95%CI(1.659, 4.316). Children coming from a household with more than three children going to school were 1.8 times likely to be malnourished compared to those from households with less than three children going to school, OR = 1.841, 95%CI (1.155, 2.935).

Table 6: Association between household characteristics and nutritional status

		Nutritional status			95% C.I.for OR		
		Malnourished n(%)	Well-nourished n(%)	P-value	OR	Lower	Upper
Main source of food	Bought and Donated	56(43.5)	81(49.1)	0.192	Ref		
	Homegrown and bought	31(24.0)	46(27.9)	0.098	1.59	0.917	2.78
	Donated	42(32.6)	38(23.0)	0.125	1.64	0.871	3.08
Number of meals per day at home	One	58(45.7)	79(47.6)	0.752	Ref	1.07	1.70
	More than 1	67(54.4)	87(52.4)			0.679	1.70
Number of people in household	≤5 people	18(14.0)	45(27.1)	0.007	Ref	2.29	4.19
	> 5 people	111(86.0)	121(72.9)			1.253	4.19
Children in Household	≤ five children	43(33.3)	95(57.2)	P<0.000	Ref	2.67	4.31
	> five children	86(66.7)	71(42.8)			1.659	4.31
Children going to school in household	<3 children	52(40.3)	92(55.4)	0.01	Ref	1.84	2.93
	> 3 children	77(59.7)	74(44.6)			1.155	2.93

### 5.2. Association between household head characteristics and nutritional status

A Fisher's exact test was performed to determine the association between household head characteristics and nutritional status. An independent sample t-test was also performed to determine whether there was difference in nutritional status based on household head age. The

findings revealed that, level of education, ( $p = 0.036$ ) and employment status of the household head ( $p = 0.040$ ) were significantly associated with malnutrition as shown in Table 7.

Table 7: Household head characteristics and nutritional status

		Nutritional status		P-value
		Malnourished	Well nourished	
Age	Mean ( $\pm$ SD)	43 $\pm$ 11	42 $\pm$ 10	0.684*
Head of household	Father	93(73.2)	109(66.1)	0.189
	Mother	34(26.8)	56(33.9)	
Marital status	Single	5(4.0)	7(4.3)	0.381
	Married	103(82.4)	126(76.8)	
	Divorced/separated	4(3.2)	3(1.8)	
	Widowed	13(10.4)	28(17.1)	
Level of education of head of household	None	88(68.8)	93(56.4)	<b>0.036</b>
	Primary	27(21.1)	35(21.2)	
	Post-secondary	8(6.3)	21(12.7)	
	Adult education	4(3.1)	6(3.6)	
	No data	1(0.8)	10(6.1)	
Employment status of head of household	Casual	44(34.4)	50(30.3)	<b>0.040</b>
	Self employed	22(17.2)	16(9.7)	
	Unemployed	39(30.5)	63(38.2)	
	No data	3(2.3)	0	
	Employed	20(15.6)	36(21.8)	

\*independent sample t-test

#### 4.5.4. Institutional based factors and malnutrition among children

School based factors were also evaluated to determine whether there was association with malnutrition as shown in Table 8. The findings revealed that there was no association between

school-based factors and malnutrition development among children. All the schools were providing feeding programs to their pupils.



Table 8:Institutional based factors and malnutrition

		Nutritional status		P-value
		Malnourished	Well nourished	
Meals given in school	One meal	123(95.3)	159(95.8)	1.0
	More than 1	6(4.7)	7(4.2)	
Types of food in feeding program	Plant based food	125(99.2)	154(99.4)	1.0
	Animal based foods	1(0.8)	1(0.6)	

## 6. Multivariate analysis

A multivariate analysis was conducted to determine independent risk factors for malnutrition. The model was developed by including all variables that were significantly associated with being malnourished under bivariate analysis as shown in Table 9. The findings showed that, number of people in household greater than 5 people ( $p=0.004$ ), AOR = 2.688, 95%CI (1.375, 5.255), number of children in household more than five ( $p <0.0001$ ), AOR =2.916, 95%CI(1.673,5.081), Household head education, primary education ( $p =0.015$ ), AOR =0.070, 95%CI(0.008, 0.601) and post-secondary level education ( $p =0.018$ , AOR=0.069, 95%CI(0.007,0.639), and unemployed status ( $p=0.029$ ), were independent predictors of malnutrition among children as shown in Table 9.

Table 9:Multivariate analysis

		P-Value	AOR	95% C.I.for AOR	
				Lower	Upper
Number of people in household	≤ 5 people		1		
	>5 people	0.004	2.688	1.375	5.255
Number of children in the household	≤ 5 Children in HH				
	>5 Children in HH	0.000	2.916	1.673	5.081
Number of children going to school in a household	≤ 3 Children going to school		1.000		
	>3 children going to school	0.156	1.464	0.865	2.478
Number of meals served in school	One meal		1.000		
	More than 1 meal	0.136	2.659	0.735	9.613
Highest level of education	None	0.100			
	Primary education	0.015	0.070	0.008	0.601
	Post-secondary education	0.018	0.069	0.007	0.637
	Adult education	0.098	0.138	0.013	1.445
	No data	0.077	0.096	0.007	1.285
Employment status	Casual	0.199			
	Self employed	0.233	0.616	0.277	1.366
	Unemployed	0.029	0.355	0.140	0.899
	No data	0.699	0.861	0.403	1.840
	Employed	0.999	0.000	0.000	
	Constant	0.277	3.850		



## **CHAPTER FIVE : DISCUSSION**

The study sought to investigate the prevalence and determinants of malnutrition in school going children between 6 and 14 years in Bor Town South Sudan. The findings from the study found that, the prevalence of acute malnutrition using MUAC was 44%. Further assessment of the nutritional status found that, 28.5% of the children were underweight, 11% were wasted while only 4.5% of the children were stunted. The findings further affirmed that malnutrition was higher among children between 10 and 14 years as compared to those aged between 6 and 9 years. This could be attributed to the growth patterns among the 10 and 14 years because of the adolescence which is associated with increased need for nutritious food products for their growth. Similarly, in the schools that were giving food programs, younger children below 10 years were prioritized in the feeding program as compared to older pupils which could have a major influence on their nutritional status. In a study conducted in Nigeria investigating stunting in children, age of the child was a key factor predicting malnutrition (36). These findings are comparable to those found in this present study which revealed that there was a higher prevalence of malnutrition in children between 10 years and 14 years as investigated. In addition, a study conducted in Madagascar in 2019 by Aiga et al found that, older schoolchildren had a significantly greater likelihood of being stunted, underweight and thin (4).

However, the prevalence of malnutrition as found in the present study are lower than the previous study conducted in South Sudan by Charchuk (11) which reported 73% malnutrition. The study was conducted at the height of war in South Sudan which could have had a major influence on the high rate of malnutrition. Underweight has also been the most prevalent form of malnutrition although at a much lower prevalence. The eight-year period between the studies could also have played a fundamental influence on the changing nutritional patterns in the country. The prevalence of malnutrition as obtained in the study are comparable to other countries as found by Akombi et al in a meta-analysis conducted investigating child malnutrition in Sub-saharan Africa. The study found that Burundi had the highest rate of malnutrition at 57%, Malawi had 47%, Niger had 44%, Mali had 38%, Sierra Leone recorded 38% while Niger had 37% (17). All of these countries with high rate of malnutrition in children have had long period of war and disability which have greatly affected the food supply. The

study also found comparable prevalence of underweight as observed in Burundi with 29% and Ethiopia which reported 25%. In which age group?

In assessing determinants of malnutrition in school going children, the findings from the present study revealed that, household with more than five people, household with more than five children, level of education of the head of household and employment status were independent predictors of malnutrition in school going children in Bor Town. The findings revealed that seven out of 10 households in Bor Town depend to a greater extent on donor food. The nutritional quality of the donor food does not focus on building the nutritional status of school going children and the quantities served are small. Large families within the region are faced with challenges because they are unable to get enough food to help sustain their nutritional level. Households of more than five people are difficult to feed. This is illustrated in a study conducted by Drammeh et al in 2019 which found that large families are at increased risk of hunger and thus in such situations children are the main victims (37).

The study further illustrated that many families in Sub-Saharan Africa average five children with no continuous flow of income. This is comparable to the findings in the present study which found that there was increased risk of malnutrition in families with unemployed household head. The household head as the name suggests are leaders in their households and family members look up to them because they are bread winners. If they are unable to provide for the family means that the family has to rely on donations which most times are not enough. These findings are also comparable to a study conducted in Nepal by Pravana et al in 2017 which found that illiteracy of the father, number of people in household and employment status of the father was significant predictors of severe acute malnutrition in children (25).

School feeding programs have been found to have a major influence on malnutrition status of school going children. However, in the present study, feeding programs in school did not have a significant influence on malnutrition considering that all of the schools in Bor Town which were investigated had feeding programs where children were feeding at least once in a day. These findings are consistent with a study conducted in Northern coastal region of Kenya in Kilifi which sought to investigate determinants of malnutrition. The study found that there was

no significant association between malnutrition and school feeding programs (2). Similarly, Wang et al in a study conducted in Southern part of China in 2020 investigating the effects of school feeding programs on school going children found that despite a huge financial outlay on school feeding programs, there was no significant reduction in malnutrition among school going children (38). This means that there are other factors that explain malnutrition among school going children other than school feeding programs. In another study in Kilifi, the North Coast region of Kenya, the prevalence of malnutrition among school children was estimated to be 27.5%, stunting was more commonest at 16.6% whereas wasting and underweight accounted for 2.7% and 8.3% respectively (2). Thus, malnutrition is still a major problem in developing countries and the situation is dire in countries that have experienced conflict and war such as South Sudan. However, even though the findings from the study do not show significant association between school feeding programs and malnutrition, school feeding programs have been implemented in all schools within the region and were aimed at boosting student nutritional status and influence positive growth. The presence of feeding programs in schools have been essential in triggering improved school enrolment in South Sudan because in school, children are assured of getting at least one meal per day.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATION**

### **6.1. Conclusion**

Malnutrition is still a major problem in South Sudan as evidenced by findings from the present study which found 44% malnutrition among school going children between 6 and 14 years, 4.7% of the children investigated had severe malnutrition and 39.3% had moderate malnutrition. There was higher malnutrition in children aged between 10 and 14 years with 35.9% of them had malnutrition compared to 7.8% who had malnutrition in age group between 6 and 10 years. The assessment of nutritional status found that 28.5% were underweight, 11% were wasted and 4.5% were stunted. Number of people in household greater than 5 people, number of children in household more than five, Household head education level and unemployed status for household head, were independent predictors of malnutrition among children aged 6 – 14 years.

### **6.2. Recommendation**

- Increasing home-based donations to families in Bor Town during crisis.
- Encourage adoption of home-based farming in families to alleviate the threat of malnutrition.
- Encourage household heads to seek employment which will improve their ability to take care of their households.
- Further studies are required to investigate the extent of underweight in school going children in the area.

## REFERENCES

1. WHO. The double burden of malnutrition: Policy Brief. WHO. 2016. Available from: [https://apps.who.int/iris/bitstream/handle/10665/44397/9789241599955\\_eng.pdf;jsessionid=F491AE1658ED839E30E8FC419E69ED13?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/44397/9789241599955_eng.pdf;jsessionid=F491AE1658ED839E30E8FC419E69ED13?sequence=1)
2. Dorcas ST. Prevalence and Determinants of Malnutrition Among Primary School Children in Kilifi District , Kenya a Dissertation Presented in Partial Fulfilment of the Requirements for the Degree of Master of Medicine in Paediatrics and Child Health in the University. 2013 Apr 14;4(2):38.
3. Frye KH. ASSESSING THE NUTRITIONAL STATUS OF PRIMARY SCHOOL by. 2013 Dec;3(1):1-3.
4. Aiga H, Abe K, Andrianome VN, Randriamampionona E, Razafinombana AR, Murai T, Hara M. Risk factors for malnutrition among school-aged children: a cross-sectional study in rural Madagascar. BMC public health. 2019 Dec;19(1):1-3.
5. Abebe Z, Zelalem Anlay D, Biadgo B, Kebede A, Melku T, Enawgaw B, Melku M. High prevalence of undernutrition among children in Gondar town, Northwest Ethiopia: a community-based cross-sectional study. International journal of pediatrics. 2017 Dec 12;2017.
6. Fewtrell L, World Health Organization. Water, sanitation and hygiene: quantifying the health impact at national and local levels in countries with incomplete water supply and sanitation coverage. World Health Organization; 2007.
7. Jansen W, Mackenbach JP, Zwanenburg EJ, Brug J. Weight status, energy–balance



- behaviours and intentions in 9–12-year-old inner-city children. *Journal of Human Nutrition and Dietetics*. 2010 Feb;23(1):85-96.
8. Kwabla MP, Gyan C, Zotor F. Nutritional status of in-school children and its associated factors in Denkyembour District, eastern region, Ghana: Comparing schools with feeding and non-school feeding policies. *Nutr J*. 2018; Jan (2): 134-8.
  9. Rashmi MR, Shweta BM, Fathima FN, Agrawal T, Shah M, Sequeira R. Prevalence of Malnutrition and Relationship with Scholastic Performance among Primary and Secondary School Children in Two Select Private Schools in Bangalore Rural District (India). *Indian J Community Med*. 2015 Aug (1): 74-8.
  10. Johnson DH. Briefing: The crisis in South Sudan. *Afr Aff (Lond)*. 2014 Dec (1): 1194-8.
  11. Charchuk R, Houston S, Hawkes MT. Elevated prevalence of malnutrition and malaria among school-aged children and adolescents in war-ravaged South Sudan. *Pathog Glob Health [Internet]*. 2015;109(8):395–400. Available from: <http://dx.doi.org/10.1080/20477724.2015.1126033>
  12. Hossain SMM, Leidman E, Kingori J, Al Harun A, Bilukha OO. Nutritional situation among Syrian refugees hosted in Iraq, Jordan, and Lebanon: cross sectional surveys. *Confl Health*. 2016 May (1): 674-9.
  13. Schaible UE, Kaufmann SHE. Malnutrition and infection: Complex mechanisms and global impacts. *PLoS Med*. 2007;4(5):0806–12.
  14. World Health Organization. WHO - Malnutrition. [www.who.int](http://www.who.int). 2018.
  15. FAO, IFAD, UNICEF, WFP W. The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns. Rome, FAO. 2019.

16. Pérez-Ríos M, Santiago-Pérez MI, Leis R, Malvar A, Suanzes J, Hervada X. Prevalence of malnutrition in Spanish schoolchildren. *An Pediatr*. 2018 Jun;8(6):775.
17. Akombi BJ, Agho KE, Merom D, Renzaho AM, Hall JJ. Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006-2016). *PLoS One*. 2017. Jul;1(6):793.
18. Abdel Wahed WY, Hassan SK, Eldessouki R. Malnutrition and Its Associated Factors among Rural School Children in Fayoum Governorate, Egypt. *J Environ Public Health*. 2017 Jun;1(2):875.
19. Ola E. Ahmed MYE and MHE. Nutritional status of the children under age of five in a desertified area of Sudan - Alrawakeeb Valley | *International Journal of Current Research*. *International Journal of Current Research*. 2011.
20. Gebre A, Surender Reddy P, Mulugeta A, Sedik Y, Kahssay M. Prevalence of Malnutrition and Associated Factors among Under-Five Children in Pastoral Communities of Afar Regional State, Northeast Ethiopia: A Community-Based Cross-Sectional Study. *J Nutr Metab*. 2019 Feb;8(6):775.
21. Ndemwa M, Wanyua S, Kaneko S, Karama M, Anselimo M. Nutritional status and association of demographic characteristics with malnutrition among children less than 24 months in Kwale County, Kenya. *Pan Afr Med J*. 2017 Jun;8(6):775.
22. Blössner M, Onis M De, Organization WH. Malnutrition: quantifying the health impact at national and local levels. *Environ Burd Dis Ser*. 2005 Jun;8(6):775.
23. UNICEF, World Health Organization, The World Bank. UNICEF-WHO- World Bank. *Joint Child Malnutrition Estimates: Levels & trends in child malnutrition. Africa (Lond)*.

- 2012; Dec 1(23): 13-5.
24. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, De Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*. 2013.23(12).
  25. C JM, Vipul M, Joshi HS, Professor A. Determinants of Nutritional Status of School Children Determinants of Nutritional Status of School Children -A Cross Sectional Study in the Western Region of Nepal. *Njirm*. 2011; Sep (2)21:9.
  26. Bailey J, Lelijveld N, Marron B, Onyoo P, Ho LS, Manary M, et al. Combined Protocol for Acute Malnutrition Study (ComPAS) in rural South Sudan and urban Kenya: Study protocol for a randomized controlled trial. *Trials*. 2018 Jan (1): 134-8.
  27. Katona P, Katona–Apte J. The Interaction between Nutrition and Infection. *Clin Infect Dis*. 2008;46(10):1582–8.
  28. Neervoort F, von Rosenstiel I, Bongers K, Demetriades M, Shacola M, Wolffers I. Effect of a school feeding programme on nutritional status and anaemia in an urban slum: A preliminary evaluation in Kenya. *J Trop Pediatr*. 2013;
  29. Degarege D, Degarege A, Animut A. Undernutrition and associated risk factors among school age children in Addis Ababa, Ethiopia Global health. *BMC Public Health*. 2015;
  30. Mushtaq MU, Gull S, Khurshid U, Shad MA, Siddiqui AM. Prevalence and socio-demographic correlates of stunting and thinness among Pakistani primary school children. *BMC Public Health*. 2011; Nov (1): 652-8.
  31. WHO. Interpretation guide. *Nutr Landacape Inf Syst* [Internet]. 2010;1–51. Available from: <https://apps.who.int/iris/bitstream/handle/>

10665/44397/9789241599955\_eng.pdf;jsessionid=F491AE1658ED839E30E8FC419E69ED13?sequence=1

32. Puckree T, Naidoo P, Pillay P, Naidoo T. Underweight and overweight in primary school children in eThekweni district in kwazulu-Natal, South Africa. *African J Prim Heal Care Fam Med*. 2011 Oct (2): 424-5.
33. Jagadesan S, Harish R, Miranda P, Unnikrishnan R, Anjana RM, Mohan V. Prevalence of overweight and obesity among school children and adolescents in Chennai. *Indian Pediatr*. 2014 Jul 1;82(7):362-6.
34. Tathiah N, Moodley I, Mubaiwa V, Denny L, Taylor M. South Africa's nutritional transition: Overweight, obesity, underweight and stunting in female primary school learners in rural KwaZulu-Natal, South Africa. *South African Med J*. 2013;
35. Shinsugi C, Gunasekara D, Takimoto H. Use of mid-upper arm circumference (MUAC) to predict malnutrition among Sri Lankan schoolchildren. *Nutrients*. 2020;
36. Imam A, Hassan-Hanga F, Sallahdeen A, Farouk ZL. A cross-sectional study of prevalence and risk factors for stunting among under-fives attending acute malnutrition treatment programmes in north-western Nigeria: Should these programmes be adapted to also manage stunting? *Int Health*. 2020 Sep 1;37(3):296-312.
37. Drammeh W, Hamid NA, Rohana AJ. Determinants of household food insecurity and its association with child malnutrition in Sub-Saharan Africa: A review of the literature. *Curr Res Nutr Food Sci*. 2019; ;9(1):65-75.
38. Wang H, Zhao Q, Boswell M, Rozelle S. Can School Feeding Programs Reduce Malnutrition in Rural China? *J Sch Health*. 2020; 8(1):201-12.

## APPENDICES

### **Appendix 1: consent form to the parent**

**Title of the study:** Prevalence and Determinants of Malnutrition Among Primary school children 6-14yrs in Bor town, Republic of South Sudan

**Researcher:** Dr. Chutti Mabil Yuot

**Introduction to the study:** I hereby request for your permission to recruit children between 6 and 14 years in your school.

**The Purpose of the study:** To determine the prevalence and determinants of malnutrition among primary school children between 6 and 14 years in Bor Town, South Sudan.

**Procedures:** If you allow me to recruit students from your school, I will ask general demographic information as well as taking the weight, height and MUAC measurements. They will be required to provide true information to the best of their knowledge in order to help in assessing their level of malnutrition.

**Time:** The questionnaire has simplified multiple choice questions expected to guide the researcher. Completing the questionnaire will take approximately 5-10 minutes.

**Benefit of the study:** The findings from the study will ensure that there is knowledge of the current nutritional status among primary school children between 6- 14 years. The findings will also help understand the extent of malnutrition in South Sudan, which will help in policy development.

**Risks, stress and discomfort:** There are no direct foreseen risks in you participating in this study. However, the study will require them to spare at most 10 minutes of their time and fill the questionnaire. The researcher will be available to address any issues that might arise during data collection.

**Cost and risk of loss of Confidentiality:** There will be no direct cost incurred by you neither will you receive any money for participating in this study. Data including questionnaires and file from the study will be kept locked in a cabinet during the study period. The data will be labelled with unique identity and name will be concealed to maintain confidentiality when taking part in the study. Furthermore, their names will not appear in any report or publication of the research and all your personal information will be handled with a high level of confidentiality.

**Voluntary Participation and withdrawal:** Remember, participation is entirely voluntarily. Should you consider changing your mind midway, you have the right to do so and you shall not suffer any consequence whatsoever.

**Sharing of results:** The results of this study may be presented during scientific and academic forums and may be published in scientific medical journals and academic papers.

**Participants consent**

I confirm that the researcher has explained fully the nature of the study and the extent of activities which I will be asked to undertake. I confirm that I have had adequate opportunity to evaluate and ask questions about this study. I understand that my participation is voluntary and that I may withdraw at any time during the study, without having to give a reason. I agree to take part in this study by filling in the questionnaire.

Signed by participant..... Date.....

In case of any issues or challenges related to this study, please contact me on **0718079120** or through email at **chuttimabil11@gmail.com**.

Thank you for sparing your precious time dedicated to participating in this study exercise.

**Researcher's statement**

**Interviewer:** I certify that the purpose, potential benefits and possible risks associated with participating in this research have been explained to the above participant and the individual has consented to participate.

Signature\_\_\_\_\_Date\_\_\_\_\_

**Appendix II: Questionnaire**

Questionnaire No ..... Date of interview .....

Name of interviewer .....

**Personal Data for child 6-14 years (respondent)**

- 1. Age:
- 2. Sex            Male [ ]            Female [ ]
- 3. Name of school .....
- 4. Present class.....
- 5. History of repeating .....
- 6. Weight (kg).....Kilograms.
- 7. Height (cm) .....Centimeters
- 8. Mid upper circumference ..... Centimeters

**Household Data**

- 9. What is the main source of food in the household?  
a) Bought [ ] b) Home grown [ ] c) Donated [ ]  
d) Other (Specify) .....
- 10. How many meals do you eat per day at home?

a) One [ ] b) Two [ ] c) More than two [ ]

11. How many meals are you given at school per day? .....

12. How many people live in the household? .....

13. How many children are in the household? .....

14. How many children go to school in the household? .....

15. What is your birth order? .....

### **Data On Head Of Household**

#### **Who is the guardian?**

16. Age .....

Sex            Male [ ]    female [ ]

17. Marital status

a. Single [ ] b) married [ ] c) divorced/separated [ ] d) widowed [ ]

18. What is his/her Educational level?

None [ ] Primary [ ] Secondary [ ] Post-secondary [ ] Adult education [ ]

19. Employment status

a. Casual [ ] Self employed [ ] Unemployed [ ] Employed [ ]

#### **Institutional factors**

20. Does the school implement a feeding program?

Yes [ ]

No [ ]

21. If yes, what types of food are implemented in the feeding



Plant based food [ ] Animal based foods [ ] Both animal and plant based [ ]

**Appendix III: Work Schedule**

Action	Nov 2019	Feb 2020	March – April 2020	May – Sept 2020	Oct – Nov 2020	Dec – Jan 2021
Topic identification and Proposal development						
Ethics						
Data collection						
Analysis						
Report Writing						



#### Appendix IV: Budget

Components	Unit of Measure	Duration/ Number	Cost (Kshs)	Total (Kshs)
<b>Personnel</b>				
Research Assistant	3	15	2,000	90,000
Statistician	1	1	20,000	30,000
Participants	300			
<b>Printing</b>				
Consent Form	1	2	10	20
Assent Form	1	2	20	40
Questionnaires	5	1	50	50
Final Report	10	1	10	100
<b>Photocopying</b>				
Consent Form	2	303	5	3030
Questionnaires	5	303	5	7575
Final Report	10	50	5	1500
<b>Other costs</b>				
Records Access Fee				
Pens	30	2	50	1500
Notebooks	12	2	100	2400
Final project Binding	<b>8</b>	-	<b>500</b>	<b>4000</b>
Final project printing	<b>8</b>	<b>40</b>	<b>10</b>	<b>3200</b>
Travels				<b>70,000</b>
Miscellaneous	-	-	-	<b>40,000</b>
<b>Total</b>				<b>144,305</b>

**Appendix V: ERC Application letter**

The Chairperson,

Ethics, Research and Standards Committee

Kenyatta National Hospital and University of Nairobi,

P.O BOX 20723, Code 00202

NAIROBI

Through

The Dean,

College of Health Sciences

Through

The Chairperson,

Department of Pediatrics and Child Health

Dear Sir/Madam,

RE: SUBMISSION OF MASTERS DEGREE RESEARCH PROPOSAL FOR APPROVAL

I wish to submit my research proposal titled **Prevalence and Determinants of Malnutrition Among Primary Schoolchildren 6-14yrs in Bor Town, Republic of South Sudan** for approval by your esteemed committee. I am currently a second-year student pursuing a Master's Degree in Pediatrics and child health at the University of Nairobi, College of Health Sciences.

Yours Sincerely,

Dr. Chutti Mabil Yuot

Department of Pediatrics and Child Health

University of Nairobi

## Appendix VI : Similarity Index

# PREVALENCE AND DETERMINANTS OF MALNUTRITION AMONG PRIMARY SCHOOL CHILDREN 6-14YRS IN BOR TOWN, REPUBLIC OF SOUTH SUDAN

### ORIGINALITY REPORT

<b>15%</b>	<b>8%</b>	<b>7%</b>	<b>12%</b>
MILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

### PRIMARY SOURCES

<b>1</b>	<a href="https://journals.plos.org">journals.plos.org</a> Internet Source	<b>1</b>
<b>2</b>	<a href="https://bmcpediatr.biomedcentral.com">bmcpediatr.biomedcentral.com</a> Internet Source	<b>1</b>
<b>3</b>	Submitted to University of Bedfordshire Student Paper	<b>1</b>
<b>4</b>	<a href="https://bmcpublikealth.biomedcentral.com">bmcpublikealth.biomedcentral.com</a> Internet Source	<b>1</b>
<b>5</b>	<a href="https://www.researchsquare.com">www.researchsquare.com</a> Internet Source	<b>1</b>
	Submitted to International Medical University <b>6</b> Student Paper	<b>&lt;1</b>

