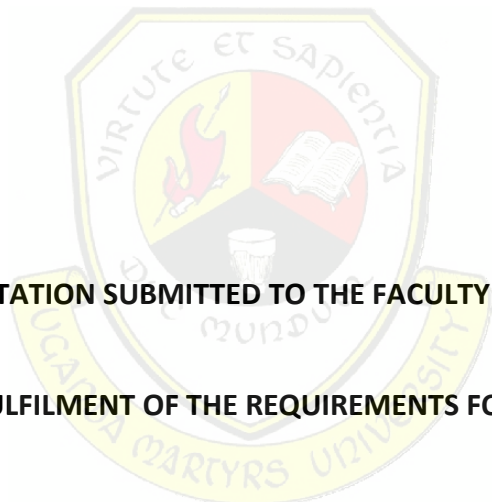


**EFFECTIVENESS OF TEACHER-BASED INTERVENTIONS IN ADDRESSING MALNUTRITION
AMONG SUB-SAHARAN AFRICAN PRIMARY SCHOOL CHILDREN: A SYSTEMATIC REVIEW**

JONATHAN NSAMBA

2015-M281-10013



A RESEARCH DISSERTATION SUBMITTED TO THE FACULTY OF HEALTH SCIENCES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD

OF A DEGREE OF MASTER'S OF PUBLIC HEALTH- HEALTH

PROMOTION OF UGANDA MARTYRS UNIVERSITY

SEPTEMBER 2016

DEDICATION

I dedicate this systematic review to my late sister Justine Namatovu. May your soul rest in eternal peace

ACKNOWLEDGEMENT

Heartfelt appreciation goes to God for the gift of life and gift of knowledge that has enabled me reach this far. I express sincere gratitude to my supervisor Dr. Everd Maniple for his guidance and transformative knowledge. Special thanks go to Vivienne Laing, my parents Mr & Mrs David Buwanga, friends, family and classmates. Specific to these, is Paul Oloya, Nicholas Yoachel, Caroline Aliga, Nakigudde Stella and Aarakit Victoria. Thank you all for your invaluable contribution to the completion of this study.

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LIST OF ACRONYMS AND ABBREVIATIONS

BMI- Body Mass Index

HFA- Height for Age

PICOS- Participant, Intervention, Comparison, Outcomes and Study design

PRISMA- Preferred Reporting Items for Systematic Reviews and Meta Analysis

WFA- Weight for Age

WFH- Weight for Height

OPERATIONAL DEFINITIONS

Anthropometry: Use of human body measurements to assess the nutritional status.

Bias: A systematic error or deviation in results or inferences from the truth.

Body mass index (BMI): The ratio of weight-for-height measured as the weight in kilograms divided by the square of height in metres.

Dietary Diversity: The consumption of highly varied diets from at least more than five food groups such as carbohydrates, protein, water, fats, vitamins and minerals.

Effectiveness: The capacity of an intervention to produce an effect

Food insecurity: A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It can be caused by poor conditions of health, hygiene and sanitation and inappropriate care and feeding practices. Food insecurity may be chronic, seasonal or transitory.

Food security: A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Macronutrients: this refers to proteins, carbohydrates and fats that are available to be used for optimal body functioning.

Malnutrition: An abnormal physiological condition caused by inadequate, unbalanced or excessive consumption of macronutrients and/or micronutrients. Malnutrition encompasses

under nutrition and the new growing transition of over nutrition as well as micronutrient deficiencies.

Micronutrients: Vitamins, minerals and trace elements that are required by the body in small amounts.

Nutrition education: Nutrition education is the use of educational strategies, accompanied by environmental support, designed to facilitate voluntary adoption of food choices and other food and nutrition related behaviors conducive to health and well being.

Nutrition sensitive interventions: Interventions designed to address the underlying determinants of nutrition (which include household food security, care for mothers and children and Primary Health Care services and sanitation) but not necessarily having nutrition as the predominant goal.

Nutrition specific intervention: Programmes that target and address the immediate determinants of malnutrition including inadequate dietary intake, feeding, child care giving practices, inadequate food intake, micronutrient supplementation and treatment of acute malnutrition.

Nutritional status: The physiological state of an individual that results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients.

Over nutrition: A result of excessive food intake relative to dietary nutrient requirements.

Overweight and obesity: Body weight that is above normal for height as a result of an excessive accumulation of fat. It is usually a manifestation of over nourishment. Overweight is defined as a BMI of more than 25 but less than 30 and obesity as a BMI of 30 or more.

Quasi-randomised controlled trial: A study in which the method of allocating people to intervention arms was not random, but was intended to produce similar groups when used to allocate participants.

Random assignment: To assign participants to the conditions of an experiment at random, that is, in such a way that each participant has an equal chance of being assigned to any particular condition.

Stunting: It refers to Low height for age, reflecting a past episode or episodes of chronic under nutrition.

Undernutrition: The outcome of undernourishment and poor absorption of nutrients consumed as a result of repeated infectious disease.

Underweight: Low weight for age in children reflecting a current condition resulting from inadequate food intake and past episodes of under nutrition.

Wasting: Low weight for height, generally the result of weight loss associated with a recent period of starvation or disease.

Withdrawals: Participants who voluntarily withdrew from participation in a study before the completion of outcome measurement.

ABSTRACT

In order to address the high malnutrition rates in Sub Saharan Africa, majority of nutrition programs have continuously been streamlined through the health system yet this has not yielded results as expected. The education sector on the other hand has showed immense capacity in addressing some challenges such as elimination of short term hunger through School Feeding Programs yet little attention has been given to teachers as far as implementing health and nutrition interventions. With an increased school enrolment rate in Sub Saharan Africa, there is need to reach all these children through high impact low cost interventions.

Objectives

This study therefore set out to consolidate evidence about the effectiveness of teacher- based interventions in addressing Malnutrition in Sub Saharan Africa through a Systematic Review and Meta Analysis of literature since no study has attempted to. This study was underpinned by Barnfenbrenner's Ecological Systems theory that emphasises the role of the surrounding environment to the growth and development of a child.

Methodology

A comprehensive search strategy through online databases that included EBISCO, PubMed, BASE, Cochrane, Google Scholar, LILACS, Project MUSE, TRIP Database and Emerald Insight gave rise to 95,734 studies in total. These were identified and taken through a series of screening stages such that the most eligible as per the inclusion and exclusion criteria were included to answer the review question.

Study selection

Three studies met the inclusion criteria and these included Eboh and Boye (2006) in Nigeria; Mbithe et al (2008) in Kenya; Steyn et al (2015) in South Africa. Risk of bias assessment and quality of the study appraisals were carried out per included study.

Findings

Teacher- based interventions have a positive effect on nutrition status of primary school children, school attendances, are sustainable and reach many children. The outcome measure of standardised mean difference gave a positive outcome (0.025 at 95% CI) although this was a small effect outcome.

Limitations

There are limited numbers of high quality Randomised Controlled Trials with teachers in Primary Schools taking up active roles in the implementation process. Many studies have external personnel to implement an activity which leaves the teachers short of knowledge and skills for sustainability of the interventions.

Recommendations

There is need to actively involve teachers in the primordial and primary prevention stages of malnutrition through strengthening nutrition education, supplementary programs and school gardening. This therefore calls for training, capacity building and empowerment of teachers as drivers of change.

Conclusion

Teachers have a big role to play in the fight against Malnutrition in Sub Saharan Africa since there are more schools than health facilities and more teachers than health workers.

CHAPTER ONE

1.1 Introduction

In recent years, a growing body of evidence suggests an existence of a double burden of malnutrition characterized by under and over nutrition existing concurrently among Sub Saharan primary school children (Natale et al, 2013; World Health Organisation, 2013; Dimpleby and Vincent, 2013). To address this double burden, many nutrition specific and sensitive interventions (Ruel and Alderman, 2013) continue to be implemented in the region. These are mainly streamlined through the health sector albeit yielding minimal short term successes as far as improving nutrition indicators is concerned in spite of the enormous inputs in terms of resources. Does this call for a permutation of approach to involve primary school teachers?

Sub Saharan Africa has the highest rate of malnutrition among children globally (FAO, IFAD and WFP, 2015; UNWFP, 2012; World Bank, 2015). The prevalence of stunting and overweight has moved from 4.8 to 6.1 and 7.5 to 15.5 million children respectively between 1990 and 2014. (FAO, IFAD and WFP, 2015). In Sub Saharan Africa, one in four children are under nourished (25%) and this is the highest under nourishment rate in any region (FAO, 2015, World Bank, 2006; Jesmin et al, 2011).

Addressing malnutrition in Sub Saharan Africa requires a multi- sectoral approach involving various sectors such as Health, Education, Agriculture, Gender and Social Development, Trade and Industry, Water and Sanitation among others (Engelbert et al, 2013; Kulwa et al, 2014). The

rationale for a multi sectoral approach arises from the recognition that prevention and control of malnutrition requires a synergy of an integrated response to break its viscous cycle (World Bank, 2015). The education sector has demonstrated immense capacity in addressing hunger and malnutrition through various approaches such as school feeding programs, school gardens, health and nutrition education (James and Belot, 2009).

Therefore, teachers in education institutions are not only agents of knowledge, but also investments in health. Teachers can have invaluable influence on the overall wellbeing of children including their nutrition status because of the considerable amount of time they spend together and the wide array of knowledge they impart in these children (Androutsos et al, 2014). In Sub Saharan Africa where malnutrition rates are deplorably high, their roles cannot be over emphasised. Thus, there is need to explore the feasibility of teachers as alternative channels for addressing the persistent determinants of malnutrition in Sub Saharan Africa.

Drawing from Barnfenbrenner's Ecological Systems theory, teachers are part of the Micro and Meso systems that has a great influence on children. This unique position of teachers presents an opportunity to repeatedly teach learners about food and nutrition early in life since food tastes develop at an early age and the distinct emotional bond they share with children can be used to influence learners' dietary habits (Shepherd et al, 2010). Despite the clear potential for school and teachers to improve nutrition indicators in Sub Saharan Africa, the evidence base for this relationship is not conclusive (Smith, 2015; Acham et al, 2012). Through a systematic review of literature, this study will attempt to provide consolidated evidence to show the

effectiveness of teacher- based interventions in improving the nutrition status of children in Sub Saharan Africa.

1.2 Background

Malnutrition is one of the major Public Health problems in Sub Saharan Africa, not only because of the sheer numbers of children affected, but the severe manifold consequences that are insurmountable to both the children and the communities affected. According to FANTA-2 (2010), malnutrition contributes to 11% of the disease burden globally and 60% of deaths among children (Fiszbein, Kanbur and Yemtsov, 2014). Malnutrition exists either as over or under nutrition characterised with overweight, wasting, stunting, under weight (FAO, 2014) and micronutrient deficiencies that can take different forms such as Vitamin A deficiency, Iodine deficiency and Anaemia.

According to FAO, IFAD and WFP (2015), 159 million children in the world are stunted, 41 million are overweight and 50 million are wasted. Oedematous and non-Oedematous malnutrition are the two forms of Protein Energy Malnutrition, the distinction being the presence or absence of Oedema (Montero and Ubach, 2010). In addition, children are plagued by micro nutrient deficiencies in Iron, Iodine, Zinc and Vitamin A, which hamper proper growth and development (UNSCN, 2011; Miller and Welch, 2013).

Sub Saharan Africa is home to most of the food and nutritionally insecure children in the world (Fanzo, 2012). According to WFP (2012), 66 million primary school age children attend school on empty stomachs across the developing world with 23 million in Sub Saharan Africa alone.

The region has the world's highest rate of stunting among children (43%) and has shown little improvement in the past fifteen years (Engelbert et al, 2013). Countries with the highest under nutrition rates are Chad, Eritrea, Ethiopia, Madagascar and Uganda. Out of the twenty countries with the highest prevalence of stunting in the world, nine are in Sub Saharan Africa (Brantuo, 2009). On the other hand, Senegal has been successful in reducing stunting on account of integrating other sectors in a multi-sectoral approach to this Public Health challenge making it the country with Africa's lowest rate (19%) of stunting (World Bank, 2015).

Malnutrition is often silent in form of micronutrient deficiencies such as Vitamin A, Iodine and Zinc yet even mild or moderate malnutrition can cause death, accentuate infections and affect intellectual capabilities of children (World Bank, 2015). While some children suffer from transient episodes, the majority go through chronic and prolonged periods of inadequate dietary intake. As articulated by the UNICEF conceptual Framework of Malnutrition (1990), social environments like schools constitute the underlying determinants of malnutrition (FAO, IFAD and WFP, 2015; Gross et al, 2000) and the Bronfenbrenner's Ecological Systems theory posits that schools and teachers, as immediate caregivers (Framework, 2006), are both at micro and meso systems that affect the health and wellbeing of a child (Bronfenbrenner, 1989; Sandberg, 2008; Ishimine, 2011).

Malnutrition is a complex phenomenon (Pieters et al, 2013) that is determined by a myriad of multifaceted and interrelated factors including poor child care practices, poor sanitation and hygiene, poor dietary intake and infections among others (Chesire et al, 2008). Consequently, no single intervention can effectively prevent, treat or control malnutrition. To this end, a

confluence of interventions including the use of teachers to impart nutrition knowledge, micronutrient supplementation, school feeding programs and school based de-worming programs can reduce the lofty burden of malnutrition.

Malnutrition has far reaching and multifarious consequences to a child. It has pervasive effects on the cognitive development (Hoddinott et al, 2013), physical growth and predisposes the child to higher risk of non-communicable diseases later in life (Judith and Sari, 2011; Smith and Haddad, 2015). Nutrition also hampers intellectual development, learning ability (Haddad, 2012) and school performance (James and Belot, 2009). Therefore; proper nutrition is a cornerstone of proper health and wellbeing of a child.

Compelling evidence suggests that nutrition, health and education are inextricably inter-linked since proper nutrition leads to healthy children attending school who achieve better grades at school which in turn is associated with improved health later in life (Inegbenebor, 2014; Bundy et al, 2006). The World Health Organization's health Promoting Schools approach is geared towards integrating Health, Nutrition and Education. The Ottawa charter recognises that health is enabled and facilitated by people within areas where they spend their everyday lives (World Health Organization, 1986). This therefore calls for re-orientation of health services to make use of teachers as a cost effective approach to address malnutrition.

In addition, education is critical to development both as a human right and a principle element in human capital development. As said by *Mistral, 1948*,

"We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the foundation of life. Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made and his senses are being developed. To him we cannot answer "Tomorrow". His name is "Today".

In reference to Mistral, schools therefore offer an established network, broad channel, effective and an equal opportunity setting and platform for imparting nutrition knowledge in many children whose life stage is formative and influential in growth and development (World Health Organisation, 2013). The formative stage is a critical stage of development during which lifestyles such as eating patterns are developed, tested and adopted through social interactions within the school.

The 1,000 days between pregnancy and a child's second birthday is considered a window of opportunity for positive impact on a child's cognitive and physical development (Casanovas et al, 2013). Whereas Bhutta et al (2009), Behrman, Alderman and Hoddinott (2004) and FANTA- 2 (2009) argue that the only window of opportunity is the first 1000 days of life and further contend that nutrition programs in schools reach children late and therefore have little effect on nutrition outcomes especially stunting in children, Prentice et al (2013) used data from Brazil, Guatemala, India, Philippines, Gambia and South Africa to show that substantial height catch-up can occur between mid childhood and adulthood. This underscores the fact that childhood and adolescence stages represent an additional window of opportunity during which substantial growth and development take place.

This is in agreement with Thurnham (2013), Toe et al (2015) and UNICEF (2013). On account of Bhutta et al (2009) and FANTA- 2 (2009) studies, children and adolescents in primary schools are particularly vulnerable to malnutrition since priority in nutrition programming is normally given to the first 1000 days. Findings of Thurnham (2013) therefore provide a basis for nutrition intervention beyond the 1000 days. Thus, teacher- based nutrition interventions hold a central role given that they are implemented within schools and target the period beyond the 1000 days window of opportunity. Such teacher- based interventions have the potential to yield substantial impact on the health, nutrition status and well being of school children in Sub Saharan Africa.

Sub-Saharan Africa has had one of the best improvements in school enrolment of any region in the world since the Millennium Development Goals were set (United Nations, 2015). Sub Saharan Africa achieved a 75% increase in the net enrolment rate making up approximately 144 million children enrolled in primary schools (United Nations, 2015). All these children spend a considerable part of their lives in school with teachers who have an opportunity to influence their nutrition behaviours (Yunusa, 2014). With many children in school today, we must ensure that teachers are nurturing healthy children.

According to Urban (2007), the influence of teachers is not only limited to boarding schools, but also day schools since even with less contact time available, teachers are able to influence the plethora of factors determining the nutrition status of children. These factors include lunch served at school, extra co- curricular activities, hygiene and sanitation environment, health and nutrition education. Children out of school also benefit from teacher- based interventions such

as de-worming which reduce disease transmission in the communities. Unfortunately, they miss out on knowledge and skills passed on through nutrition education that inculcates in children, the ability to make informed food choices.

Teachers are a critical part of the social environments that shape pupils' early food habits and choices since these children are very amenable to many factors that affect their eating patterns at this stage of life (Kulwa et al, 2014). The behaviours learned during early years for example, those related to food choices are carried on to adulthood (Yunusa, 2014) and children trust in what their teachers inform them.

As far as addressing malnutrition is concerned, primary school children deserve more attention than received in the past because at this stage, unhealthy food patterns can be established (Natale et al, 2013). It is also a time when nutrition knowledge, skills and values can be best acquired for proper growth and development (WHO, 2009). When school children are provided with adequate nutrition concepts at formative and influential stages, they are likely to respond positively to nutrition education and dietary messages (Kulwa et al, 2014; Garcia et al, 2011; Jansen et al, 2011; Thammaraksa et al, 2014).

Many schools especially in the urban cities have obesogenic environments characterised by conditions that promote obesity in children such as too much energy intake and sedentary behaviour. These environments influence which foods are available and whether the children in schools are eating healthy diets (Lake and Townshend, 2016). Therefore, altering and shaping the school environment to better support healthful dietary patterns has the potential to reduce

the exponential rise of obesity among school children and hence influence their lifelong eating patterns (Lipek et al, 2015).

Further to this, the responsibility of promoting behaviour change and nutrition interventions falls on the shoulders of teachers. They are in a unique position to positively influence nutrition behaviours by advocating better dietary practices such as consumption of fruits, vegetables, use of iodised salt and increase in physical activity levels through Physical Education classes and health talks. Teachers can discourage the sale of fizzy drinks especially in urban school canteens, create and encourage informed food choices, redress dietary practices such as consumption of high sugar and fat content processed foods that are common among school pupils (Jesmin et al, 2011; Ogden et al, 2010; Chesire et al, 2008).

Understanding and mainstreaming the role of teachers is fundamental if today's children are to establish healthy dietary lifestyles that will contribute to the prevention and control of malnutrition. An evaluation study by Adelman et al (2008) showed that a supplementary feeding program implemented by teachers in Northern Uganda reduced the prevalence of Anaemia for primary school children 10- 13 years. Another study by Somsri et al (2006) showed that nutrition education program improved fruit and vegetable consumption among Thai Students. Therefore, teachers are in a pole position to influence nutrition outcomes among primary school children positively.

In Sub Saharan countries, there are 23.9 million teachers and this size of teachers is of Public Health significance (UNESCO, 2015). This means that there are more teachers than health workers and more schools than health centres (Bundy et al, 2006). Teachers are salient factors

in child growth and development and can therefore attenuate bad eating patterns, prevent malnutrition, identify and refer malnourished cases when necessary and treat when possible and effective through use of locally prepared therapeutic foods.

The continuous regular contact between teachers and children presents an opportunity for health and nutrition education. However, the roles of teachers cannot be effectively implemented if they lack sound knowledge and skills. In addition, there is limited institutional support and capacity building given to the teachers. Training of teachers in delivering nutrition interventions is paramount as it builds the commitment, understanding and skills to effectively deliver the interventions.

The pivotal role of teachers in school nutrition promotion needs to be given more priority. Teachers can be supported to increase their health and nutrition literacy through basic training in assessment, management, prevention and control of malnutrition. They can also be supported to assume responsibility of being role models for health. The opportunity this posits is that malnutrition can be prevented and treated with simple inexpensive interventions such as school lunch, de-worming, supplementary programs, Growth Monitoring and Promotion.

Further to this, nutrition sensitive interventions such as improved water, sanitation and hygiene, improved health services, agricultural initiatives, school gardens, school feeding programs and nutrition specific interventions in schools such as nutrition screening for deficiency diseases, nutrition education to the pupils, use of iodised salt and micro nutrient supplementation are dependent on teachers (Ruel and Alderman, 2013; Black et al, 2013).

Hence, they provide the most cost effective means of improving nutrition status of pupils and thus advance social and economic development (Jesmin et al, 2011).

Several studies (Caruso et al, 2014; Sherman & Muehlhoff, 2007; Steyn et al, 2015; Jansen et al 2011; Jonas et al 2011) that have explored the effectiveness of teachers in prevention of malnutrition have yielded tangible results that can be used to guide program strategies and therefore be adopted in Sub Saharan Africa. Therefore, malnutrition can be mitigated at the earliest levels through teacher-based interventions, which put forward timely preventive than the current expensive curative approaches of the health sector. Without much effective approaches and interventions, malnutrition will continue to inflict irreversible effects to children.

1.3 Problem Statement

Although evidence (FAO, 2015) suggests that significant achievements had been made on the Millennium Development Goal target [1C] “to halve, between 2000 and 2015, the proportion of people who suffer from hunger”, major failures were recorded mainly in Sub Saharan Africa. The region has remained the global hotspot for hunger and malnutrition. The number of stunted children increased by about one third between 2000 and 2015 and 23 million children still attend school hungry (World Bank, 2015; FAO, 2015). Malnutrition undermines physical and intellectual growth and development (Bain et al, 2013) and’ contributes to more than one third of all cases of child mortality (Ejaz and Latif, 2010). Yet, countries in Sub Sahara have failed to effectively address malnutrition pointing to lack of well tested integrated approaches in nutrition programming (Fanzo, 2012).

Ideally, no child should be dying from preventable ill-health conditions such as malnutrition. Every child has a right to enjoy the maximum attainable quality of life, which calls for a need to eliminate malnutrition. Teachers in primary schools have an opportunity to influence children's nutrition status through school feeding programs, nutrition education, school gardening, screening and treatment and supplementary programs among others. The opportunity of going to school should be exploited maximally. Unfortunately, the potential role of teachers is under-utilised. They are less prioritised and valued hence have continuously received little attention as far as nutrition interventions are concerned. Yet, they are able to offer low cost high impact nutrition and health interventions. This is due to lack of consolidated evidence from synthesised literature such as systematic reviews to demonstrate the potential and critical role of teachers in nutrition.

In Sub Saharan Africa, no systematic review has attempted to make a strong case for the effectiveness of teacher- based interventions and this gap underpins the need for this study. It is in light of this foregoing that this study will seek to create a strong base of evidence over the critical role that teachers can play in the fight against malnutrition.

1.4 Aim of Systematic Review

Given the role of teachers as part of the environmental influences on nutrition status of pupils (Brown et al, 2010), a systematic review will provide a means of synthesising and evaluating evidence from multiple primary studies in a rigorous and transparent way.

The gap to address in this review will be the evidence gap on effectiveness of teacher- based nutrition interventions. This study will provide consolidated evidence from various studies and elicit conclusions on the effectiveness of teacher- based interventions towards the prevention and control of malnutrition in Sub Saharan African countries. The study tried to reduce research and practice gap by proposing policy recommendations, which can be drawn upon by policy makers, educators, health personnel and the public in order to involve teachers in the prevention and control of malnutrition in Sub Saharan Africa. This will provide ground for nutrition programming as we embark on the sustainable development goal No. 2 to End hunger, achieve food security and improved nutrition and promote sustainable agriculture

1.5 Objective of Systematic Review

1.5.1 Main Objective

To summarise and synthesise the findings of identified studies and elicit conclusion to inform current and future nutrition programming about the effectiveness of teacher- based nutrition interventions in addressing malnutrition in Sub Saharan Africa.

1.5.2 Specific Objectives

1. To identify and synthesise eligible empirical studies that have explored the role and effectiveness of teachers in nutrition management in schools.
2. To document lessons that can be learnt from implementing teacher- based interventions towards prevention of malnutrition among school children?
3. To find out the existing research gaps in the available body of Literature on the subject

of Integrated Management of Acute Malnutrition in Sub Saharan Africa.

1.6 Justification

Teachers in schools are central to the health sector as an avenue through which interventions that aim to improve nutrition status of children can be put into practice. Teachers therefore offer an alternative channel and approach to addressing chronic malnutrition in Sub Saharan Africa.

The study findings, insights, conclusions and recommendations will furnish and enlighten about an alternative nutrition programming approach to policy makers, Ministries of Health, Ministries of Education, Project Directors, Donors, school administrators, officials in agencies, institutions, community leaders, researchers and the general community as we try to address the burden of malnutrition focusing on Primary Health Care components such as school nutrition programmes as part of the wide integrated health activities.

1.7 Review Question

This review will answer the key question “Can teacher-based interventions address malnutrition among school children in Sub Saharan Africa?”

1.7.1 Specific Questions

1. What comparison differences exist in nutrition outcomes of primary school children who receive or do not receive teacher- based nutrition interventions?
2. What lessons can be learnt from implementing teacher- based interventions towards

prevention of malnutrition among school children?

3. What are the existing research gaps in the available literature on the subject of roles of teachers in management of malnutrition?

The review question conformed to the PICOS framework as summarised below:

Table 1 showing the PICOS framework

Population	Intervention	Comparison	Outcome	Study Design
Primary School children	Nutrition Education School Feeding School Gardens	Health Sector nutrition programming	Nutrition status of school children, Stunting, Wasting Underweight	Randomised Controlled Trials, Quasi Experimental studies

1.8 MESH Words

The Medical Subject Headings aided in the search strategy. The MESH words are National Library of Medicine Thesaurus used to index articles for PubMed or Medline databases to focus the search strategy for more relevant articles. The search strategy as used in PubMed used words such as "Food habit", "nutritional status", "child", "food", "knowledge", "body weight", "school", "school children" and is attached in Appendix I.

1.9 Scope of Review

The search of electronic databases and search engines was undertaken to find relevant papers pertaining to the review question and that were published in any Sub Saharan country between 2000- 2015.

1.10 Theory underpinning the study

This study is informed by Bronfenbrenner Ecological Systems Theory which emphasises the roles played by the characteristics of the external environment in which the child finds him/herself and how it interacts to influence the way the child grows and develops. The child finds him/herself enmeshed in different ecosystems; home, school, society and culture. The focus of this study will be grounded on the Micro and Meso systems of Bronfenbrenner Ecological Systems Theory.

The Micro system is the most immediate environment in which the child lives such as the home, school, and peer groups. More nurturing and supportive interactions will foster proper child growth and development. The Meso system refers to the interactions of different micro systems that affect child development (Bronfenbrenner, 1989; Ryan, 2001).

Therefore, by understanding the different systems that simultaneously affect a child, the Bronfenbrenner's Ecological Systems Theory is able to demonstrate the diversity of interrelated influences on child health (Ishimine, 2011). Teachers are part of the Micro system and thus have an opportunity to influence the nutrition status of a child and the Micro system contains the structures within which the child has direct contact.

CHAPTER TWO: METHODOLOGY

2.1 Introduction

A systematic review identifies, evaluates, selects and synthesises evidence relevant to a research question. Systematic reviews of high quality Randomized Control Trials are crucial to evidence-based Public Health and have gained popularity to better understand the impact of various interventions so as to apply the evidence of research findings to address Public Policy issues. This review was carried out using the Cochrane Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Moher et al, 2009).

2.2 Protocol and registration

The protocol was not registered at PROSPERO, the prospective registration platform for Systematic reviews. This was due to limitations of accessibility. Despite this, internet sources and databases were searched to rule out any existing reviews published about the same topic.

2.3 Eligibility criteria

The eligibility of studies to be considered for this review included studies published between 2000 and 2015. This time frame was considered because it marked the exponential increase in school enrolment of children as a result of the Millennium Development Goals. The Inclusion and exclusion criteria were specifically followed to trickle down to the most eligible studies to be included in this review.

2.4 Inclusion and Exclusion Criteria

The study used the following criteria to identify potentially relevant primary studies:

2.4.1 Inclusion Criteria

- (i) **Intervention:** The study did not review all teacher- based interventions, but only those that have the explicit goal of improving the nutritional status of children. Only three teacher- based nutrition interventions were considered; nutrition education, school feeding programs and school gardening on account that they are nutrition specific. All these three interventions address the nutrition needs of school children.
- (ii) **Geographical location:** studies conducted in any country of Sub Saharan Africa as classified by the World Bank.
- (iii) **Population:** studies carried out targeting School children- boys and girls in either single or mixed schools located in urban or rural settings.
- (iv) **Study design:** Only Randomised Controlled Trials and quasi experimental studies were considered for this review. Studies that compared before and after the intervention strategy were included (pre-post). Quasi-experimental designs were considered on the basis of matching since it makes groups comparable for characteristics that can affect the outcome (confounders) although Randomised Controlled Trials were preferred since they are regarded as the gold standard.
- (v) **Sample size:** Studies that were carried out in more than one school.

- (vi) Date: Studies published in peer reviewed journals between 2000 and 2015 because this time period marked an exponential rise in school enrolment across Sub Saharan Africa as a result of the Millennium Development Goals.
- (vii) Language: Only English Language articles were eligible for inclusion because it is the primary language of the researcher. This perhaps could have limited the inclusion of some eligible studies published in other languages.
- (viii) Online databases: The online databases searched had to be freely accessible through Uganda Martyrs University electronic library resources and had to allow saving of search strategies.
- (ix) Outcomes: Studies that were included should have reported nutrition anthropometry- wasting, stunting, and underweight, nutrition knowledge, program participants, cost effectiveness, and contextual factors such as sustainability.

2.4.1 Exclusion Criteria

Studies were analysed against the inclusion criteria precisely. This review excluded all primary studies that were non peer reviewed and out-of-date (i.e. before 2000 and after 2015). Systematic reviews were also excluded since this was not a review of reviews. Unpublished studies and grey literature, with the exception of Google scholar were excluded on account that they were not peer-reviewed although the review acknowledges publication bias. Publication bias therefore occurs when studies that obtained statistically non significant findings do not submit their manuscripts for publication or their manuscripts are rejected for publication.

Other papers that were excluded included; non English publications, papers from the same country, duplicates found in online sources searched, un controlled before-and-after studies, case series, case reports, editorials, case-control studies and retrospective cohort studies.

The researcher scanned through the titles to exclude studies that were out of the scope of the review. Then read the abstracts and excluded papers not meeting the criteria for study scope, type and quality. To avoid incorrectly excluding studies that could perhaps meet the inclusion criteria, the researcher always reviewed the full text when in doubt.

2.5 Primary Outcomes

Studies were included if they reported at least one of the following nutrition outcome measurements; anthropometry (Stunting [HFA], wasting [WFH] and Underweight [WFA]), nutrition knowledge, dietary diversity (measured by a food recall or Food Frequency Questionnaire), Mid Upper Arm Circumference, Vitamin A status, Iron status, food choices, dietary diversity, program participants, program cost evaluation and general quality of life.

2.6 Literature Search

The goal of literature search was to be exhaustive in acquiring a comprehensive pool of relevant studies from which, the most appropriate for the question would be selected. Databases such as EBISCO, Cochrane library, TRIP BASE, Emerald, Google scholar, EMBASE, Project Muse, PubMed and LILACS were searched since these were accessible through the Uganda Martyrs University intranet and they could save the search strategies. Medline was not searched since it uses the same data like Pubmed, only the search interface is different.

Pearling was carried out where the reference lists of included studies were examined for potentially relevant studies not captured by the search and then their references too, re-reviewed until saturation point was reached.

2.6.1 Search

The search took a period of one month; June 2016. The search for studies included those on teacher-based nutrition interventions in schools such as feeding programs, nutrition education and school gardening. The studies were screened with the aid of inclusion-exclusion criteria at two separate stages. In stage one, screening was according to titles and abstracts. Stage two involved a full-text review. The search was conducted twice and this ensured repeatability. The search process for studies included four stages:

2.6.1.1 Searching databases

In order to find a satisfactory set of key words for the search, the reviewer conducted a number of tests. The study searched using very inclusive terms such as “school”, “projects”, and “nutrition”. It was necessary to be more specific in order to find relevant articles than being sensitive to find all articles in the study area. The reviewer then searched using keywords for the three types of interventions selected, namely: “school gardening”, “nutrition education” and “school feeding”. The alerts and forwards citation utility in Cochrane and Google scholar respectively, enabled the researcher to find papers that cited the identified studies and to stay current as new references were added to the database. This covered a period of three weeks

June 13th to July 4th 2016. The truncation symbol (*) allowed for searching relatively similar words with specified beginnings.

2.6.1.2 Participants Search Words

General search terms for participants were “primary children”, “learners”, “pupils”, “and school children”, “children”

2.6.1.3 Intervention Search Words

The search words for interventions included “school gardens”, “school kitchen gardens”, “demonstration gardens”, “school farms”, “backyard garden”, “nutrition education”, “nutrition guidance”, “food education”, “school feeding programs”, “school meals”, “school lunch”, “school food”

2.6.1.4 Outcome Search Words

The outcomes search words were “nutrition status” “physical growth”, “stunting”, “wasting”, “underweight”, “physical development”, “physical fitness”, “dietary intake” “informed food choices”, “nutrition skills”.

2.6.2 General filtering of searches

The reviewer used Boolean operators “OR”, “AND” and “NOT” for all the search terms. This aided in expanding and narrowing the search results. Different databases offered varying navigation panes. The filters and limiters used are attached in the Appendix detailing the search strategies. Below is a search example in Pub Med database.

2.6.3 PubMed Search Strategy

Search	Add to builder	Query	Items found	Time
<u>#3</u>	<u>Add</u>	Search ((((((("School garden"[Title]) OR "Demonstration farm"[Title/Abstract]) OR "Demonstration garden"[Title/Abstract]) AND "Nutrition knowledge") AND "Malnutrition") AND "Nutrition status"[MeSH Major Topic]) AND "Child health"[MeSH Major Topic]	<u>0</u>	11:39:24
<u>#2</u>	<u>Add</u>	Search (((Nutrition Education[Title/Abstract]) AND Primary Schools in Africa) OR African Schools AND Malnutrition)	<u>29</u>	11:28:23
<u>#1</u>	<u>Add</u>	Search (((("Nutrition Education in schools"[Title]) OR "School feeding"[Title]) OR "School garden"[Title]) AND Nutrition status) AND School children	21	11:21:54

2.6.4 Hand searching

This review did not use hand searching to access studies since hard copies of peer reviewed journals were not available within the university library.

2.6.5 Pearling

The included papers' references were searched to identify eligible papers for inclusion. This was to enable a wide pool of eligible studies that could perhaps have not been captured by the search words.

2.7 Study selection

The study selection followed identification, screening, eligibility, and included studies stages.

This was as illustrated in the flow diagram below.

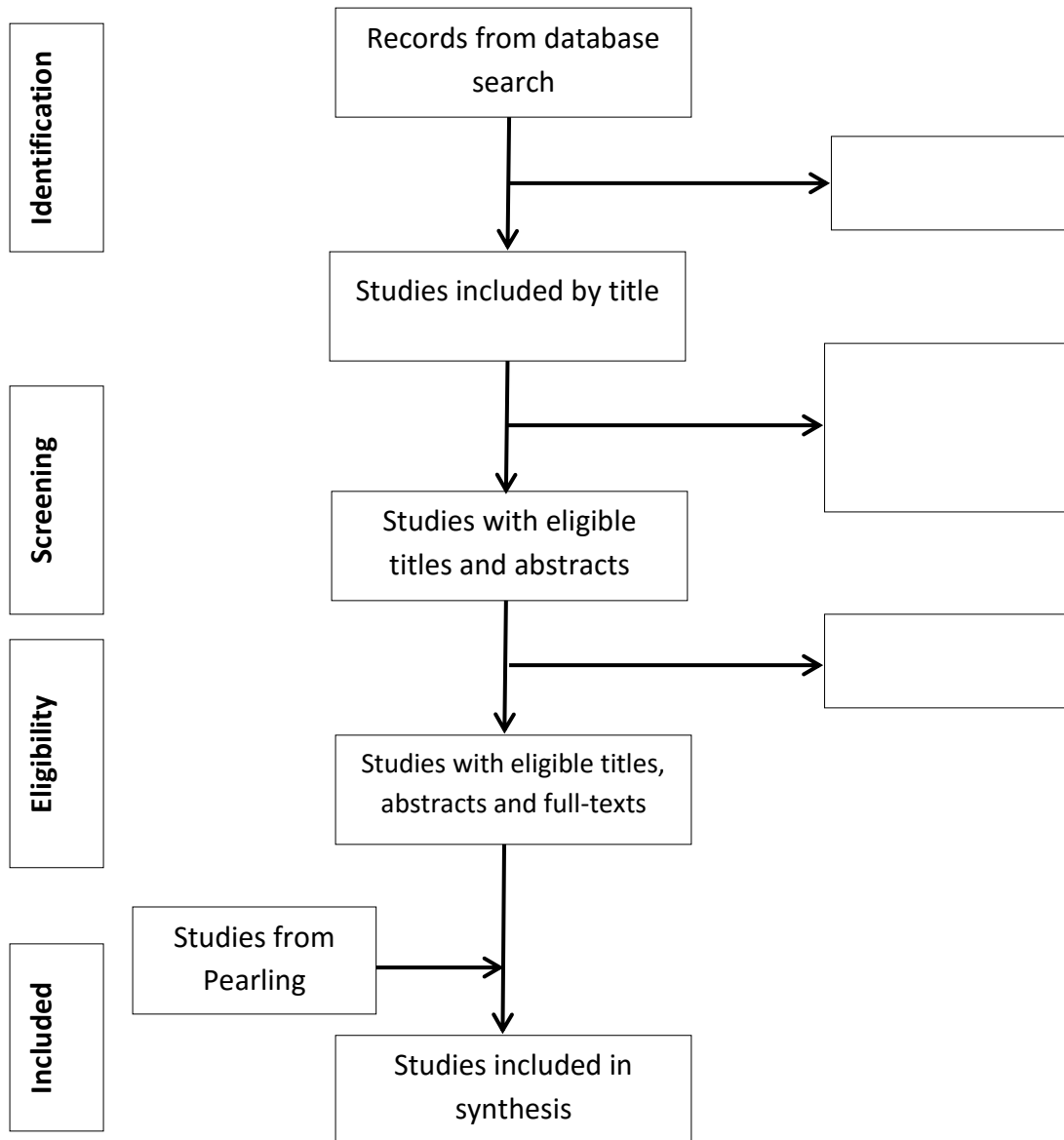


Figure 1 showing the study selection process

The studies were screened following PICOS [P – *Population*, I – *Intervention*, C – *Comparison/control*, O – *Outcomes*, S- *Study Design*] guidelines. PICO is a guideline used in evidence based practice to frame and answer a health care related question.

2.8 Screening Process

This process was key to obtaining the most eligible studies to answer the review question. After the database searches, all pooled papers were treated as one. Thus they were not classified according to the type of interventions. There was no quota method for specific interventions in this review.

2.8.1 Screening by Title

This was the first step of screening process. Search results were screened on the basis of the title. Eligible studies were then automatically saved by EndNote X7 software directly from the online databases.

2.8.2 Screening by title and abstract

The saved articles were screened further by reading the titles and the abstracts paying particular attention to study design, geographical region, intervention and outcomes.

2.8.3 Screening by title, abstract and full text

This was the last process of the screening phase. Full text review was carried out for all the eligible studies while applying the inclusion and exclusion criteria.

2.9 Quality Assessment

The reliability and validity of papers was appraised using Evidence Based Leadership checklist (Appendix IX) by Lindsay Glynn (Alcock, 2006) to ensure that high quality papers were included in the review. The quality of included Randomised Controlled studies were further appraised using a five point oxford quality rating scale- Jadad scale (Appendix VIII)

2.9.1. Risk of Bias

The quality of reviewed papers was appraised using the Cochrane's Collaboration tool for assessing risk of bias (Appendix VII). It enabled identification and resolving of bias prior to the review. In addition, four classmates independently supported the process of study identification. A pool of studies was shared so as to identify the most eligible for the study as per the inclusion and exclusion criteria. Similar studies were considered and discrepancies were settled so as to come up with the most eligible studies to answer the research question of this review. This too was geared towards minimising bias.

2.10 Data Extraction

The data extraction process followed the following the Cochrane Public Health Group data extraction and assessment template for intervention reviews Version 3 (Appendix IV). The extracted data included general information such as journal, title, author, volume, pages, objectives, type of trial, demographics of the study population, description of intervention, description of the control group, results of the interventions , how they were measured and the country setting from which the study was carried out.

The data extraction form in both electronic and hard paper, collected all the necessary data and ensured consistency of data extraction across studies. The form is a guide and a requirement so as to meet the methodological expectations of Cochrane intervention reviews (MECIR) standards for collecting and reporting information about the included studies.

2.11 Quality Appraisal

The quality of this review was upheld by the internal review appraisal from the research supervisor and some purposively selected classmates. External review appraisal was obtained from scholars out of Uganda Martyrs University who read and critiqued this piece of material. A comprehensive database search strategy yielded both published and unpublished work and the database records of the search strategy were saved.

Quality appraisal was carried out by the use of Jadad scale (Appendix VIII) to assess the quality of randomised trials based on random assignment, double blinding, and the flow of participants in either arms. The scale has seven items. The last two attract a negative score, which means that the range of possible scores is 0 (bad) to 5 (good) (Jadad et al, 1996)

2.12 Strategies for Data Analysis

A mixed evaluation of studies was undertaken and this study used the Evidence for Policy and Practice Information and Coordination Centre (EPPI) approach for data analysis. This approach is the most developed and rigorous method that integrates deductive and inductive inquiry by discussing both analyses to address different, but related elements of the same research

question. All evidence for a particular health outcome was compiled and analysis was by measures of effect sizes, emergent qualitative themes and narratives.

2.13 Synthesis of results

This study employed a random effects model since this assumes different treatment effects in all studies. The random effects model was used to account for variance in design and outcome variables. The synthesis of results was mixed involving both qualitative and quantitative approaches. The qualitative approach used thematic synthesis emergent from the body of evidence. The study used a random-effect model to perform meta-analysis. Meta-analysis was performed using the Comprehensive Meta analysis software Version 3. This computer application for Meta Analysis was developed by a team of experts in U.S.A and the U.K and it automatically computes treatment effects and creates high resolution forest plots.

2.13.1 Measures of treatment effect

The measure of effect was the strength of a relationship between two variables. Where meta-analysis was performed, the intervention effect was expressed as a standardised mean difference between the outcome measures. This was because the outcomes were continuous in nature.

2.13.2 Assessment of heterogeneity

Statistical heterogeneity was assessed via visual inspection of forest plots of the included trials. Examination of the trial characteristics such as participants, design, interventions and outcomes was also performed to identify the source of heterogeneity.

2.13.3 Publication Bias

This review did not attempt to calculate publication bias by use of funnel plots. This was because of a low number of included studies since analysis of publication bias requires ≥ 20 studies in a single review.

2.14 Outcomes

The outcome indicators of interest were:

- Program Participation [Characteristics of targeted population]
- Income [Cost analysis of the intervention]
- Nutrition status [stunting, Wasting, Obesity and Underweight]
- Sustainability of intervention

2.15 Interpretation of Results

Strengths and weaknesses of included studies were assessed and discussed explicitly. The goal was to make conclusions based on the best available evidence for decision making by the policy makers.

2.16 Dissemination Plan

Results will be disseminated through a publication after a defence session at Uganda Martyrs University- Faculty of Health Sciences.

2.17 Conflict of Interest

None

2.18 Country

Uganda

2.19 Language

English

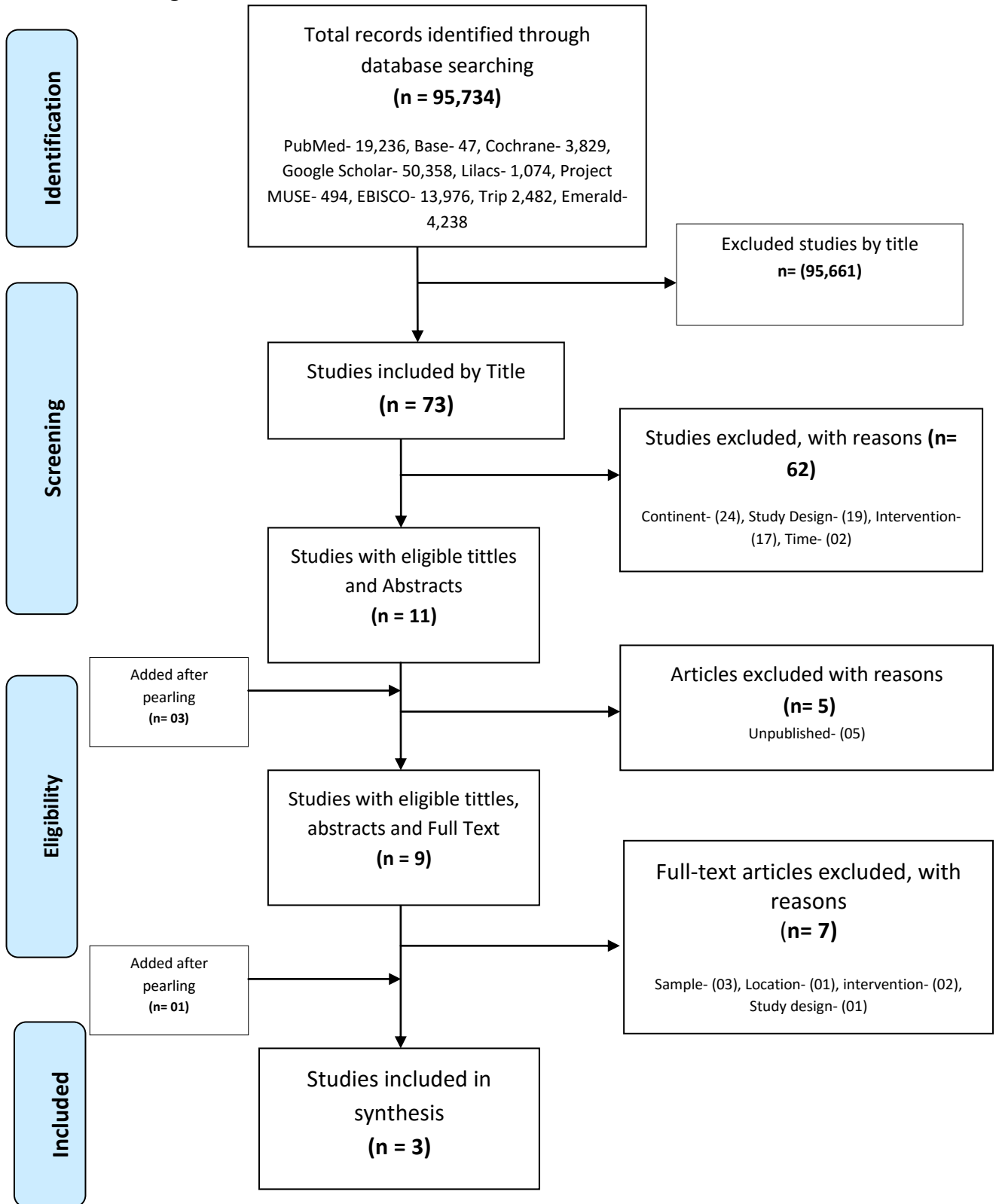
2.20 Contact Details for Further Information

Name: Jonathan Nsamba Tel: +256 772551119 Email: jonahnsamba@ymail.com

CHAPTER THREE: FINDINGS

The findings of the search strategies in the various databases yielded a total of 95,734 articles that went through a series of screening steps. These included screening by title, abstracts and full text review to narrow down to the most eligible for the research question as shown in the PRISMA flow diagram. At every stage of the screening process, reasons for exclusion of various articles were documented.

3.1 PRISMA flow diagram



In Pubmed database, the asterix was used to find similar words as the search word whereas the double quotes enabled searching for phrases.

3.2 Study Characteristics

The studies that met the inclusion criteria were three. Two were Quasi Experimental designs whereas one was a Randomised Controlled Trial. The summary of included studies was undertaken, using Garrard (2007) Matrix Method. The review matrix table provides a standard structure for detailing the author’s name, publication year, study type, study purpose, subjects, study design, analytic methods, and study findings

3.2.1 Matrix indicating study characteristics

Table 2 showing characteristics of included studies

Author	Year of Publication	Study Design	Purpose	Findings	Gaps	Recommendation
(Steyn et al., 2015)	2015	Cluster- RCT	Nutrition education and make healthier food choices	Dietary diversity	The setting used	Strengthen and implement the School Nutrition Policy
(Eboh and Boye, 2006)	2006	Quasi- Experimental	Effect of school nutrition education	Nutrition education and food choices	Inconsistencies	Structured and unstructured integration of nutrition within school curriculum
(Mbithe et al., 2008)	2008	Quasi- Experimental	To address knowledge gap	Nutrition knowledge improved significantly	Purposive sampling	- Widen nutrition education scope - Establish school gardens

3.3 Study Quality

The quality of included studies was for Steyn et al (2015) since it was the only Randomised Controlled trial. The studies by Eboh and Boye (2006) and Mbithe et al (2008), were not appraised with this tool since they were Quasi Experimental studies. The risk of bias assessment was carried out for them.

Table 3 showing study quality of RCT

Criteria of Scale	Study	Score Obtained
Randomisation	Steyn et al., 2015	+1
Method of Randomisation	Steyn et al., 2015	+1
Double Blinding	Steyn et al., 2015	0 (Open Label)
Method of Double Blinding	Steyn et al., 2015	0 (Open Label)
Dropouts & Withdraws	Steyn et al., 2015	+1
Total Jadad Score	Steyn et al., 2015	3

With a scale of <3 and ≥ 3 indicating low quality and high quality of the trial respectively, the study by Steyn et al (2015) was a high quality trial that met most of the evaluation criteria. The trial had a score of 3.

3.3.1 Validity of included studies

All the three studies included in this review met the validity of $\geq 75\%$ as per the Evidence Based Leadership Critical appraisal checklist by Lindsay Glynn (Alcock, 2006). This ensured that high quality papers were included in the review.

3.3.2 Risk of bias assessment

The risk of bias assessment was carried out for all the included three studies and their results are showed in the table below:

Table 4 showing the risk of bias assessment

Domain	Reviewer's judgement
<i>Selection bias.</i>	
Random sequence generation.	Selection bias (biased allocation to interventions) due to inadequate generation of a randomised sequence. (Eboh and Boye, 2006; Mbithe et al, 2008)
Allocation concealment.	Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment. (Eboh and Boye, 2006; Mbithe et al, 2008)
<i>Performance bias.</i>	
Blinding of participants and personnel <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Performance bias due to knowledge of the allocated interventions by participants and personnel during the study. (Eboh and Boye, 2006; Mbithe et al, 2008; Steyn et al., 2015)
<i>Detection bias.</i>	
Blinding of outcome assessment <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Detection bias due to knowledge of the allocated interventions. (Eboh and Boye, 2006; Mbithe et al., 2008; Steyn et al., 2015)

Attrition bias.	
Incomplete outcome data <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Attrition bias due to amount, nature or handling of incomplete outcome data. (Eboh and Boye, 2006)
Reporting bias.	
Selective reporting.	No reporting bias was detected in any study

3.4. Findings from Individual Studies

The evidence from individual studies included in this review was extracted to contribute to the body of evidence so as to answer the research question. This is presented below:

Study I: Did Health kick, a randomised controlled trial primary school nutrition intervention improve dietary quality of children in low- income settings in South Africa? (Steyn et al, 2015)

The health kick intervention was a three year (2009- 2011) Randomised Controlled school based nutrition and physical activity study by Steyn et al (2015) that aimed at promoting healthy eating habits, diet quality and physical activity among primary school children, parents and educators in order to reduce the risk of the increasing the burden of Non Communicable diseases such as Obesity and Diabetes. The study aimed at improving regular participation in Health Promoting physical activities in order to prevent over weight, risk of chronic diseases and to create a school environment that encourages the adoption of a healthy lifestyle. The schools were purposively selected from two low income school districts in the Western Cape Province and randomly allocated to either the control arm (n= 8) or the intervention arm (n= 8).

The schools were treated as clusters and matched to minimise confounding factors. The selected schools were paired with another school that had the same ethnic language and social

economic profile. The paired schools were then randomly assigned to either the control or the intervention arm. The intervention arm comprised of 500 learners whereas the control arm comprised of 498 learners. Measurements were made at baseline (2009), repeated in 2010 and in 2011 on the same group of learners as they progressed through classes 4, 5 and 6 respectively.

The authors sought for ethical approval from the Human Research Ethics Committee in the Faculty of Health Sciences at the University of Cape Town and from the Western Cape Education department to intervene in primary schools. The study further obtained written consent from the parents and the learners, declared the funders and no conflict of interest, gave the details of the authors for further correspondence.

Healthy messages were developed from the South African food based guidelines and were adapted to the setting. Messages developed included *“Eat a variety of foods everyday”* and *“eat many different types of fruits and vegetables every day”*. Other messages developed were *“eat less sugar and sweet foods such as cakes, doughnuts and sweets”*. These messages were very clear, which made it easier for the children to memorise and understand.

The Health Kick intervention was planned in relation to the social ecological model that looks at the effect of the surrounding environment and its interaction with the child, which eventually affects the growth, development and health. School environment was emphasised since it has the potential to improve the nutrition status of school children. Such places include school canteens, cafeterias and school gardens. The intervention had three phases that comprised of formative assessment to identify objectives and priorities for the intervention, a baseline

assessment to identify basic information and an individualised action planning phase by the teachers to increase physical activity levels and healthy eating. The Health Kick team were rather facilitators than taking responsibility for the implementation of the intervention. This ensured sustainability of the intervention, empowerment and capacity building of the school staff.

The teachers in the intervention schools were provided with training materials such as health Kick tool kit that comprised of an educator's manual, a bin with physical activity equipment, resource box with printed materials and nutrition curriculum guidelines to facilitate the active implementation of the action plans. The plans involved 15 minutes of physical activity each day and at least one activity about healthy eating each month. The intervention enabled the champion staff in the intervention schools to set their own goals and implement the activities as planned. Such activities included setting of healthy school policies, nutrition education, encouraging sale of healthy foods in school shops, encouraging healthy lunch boxes and initiation of school gardens.

This action planning process facilitated an empowerment approach to the teachers hence leading to the sustainability of the intervention. On the other hand, the educators in the control arm were provided with a booklet that contained tips and a guide for proper health and nutrition promotion although there was no intervention from the Health Kick team. This caused low differences between results in the intervention and control arms.

Results of the study showed that the mean age of the pupils was 9.9 in 2009 and 12.3 in 2011. This mid- adolescence age category is good to intervene as they are receptive to nutrition

messages and they are at a stage of rapid growth and development. The main outcome measurement was dietary diversity especially on snack foods containing high fat and sugar content. The dietary assessment was carried out by use of an unquantifiable 24 hours recall during September and November each year of the intervention. The approach could perhaps have presented limitations in obtaining different information about the consumption patterns for the three years because the season could be specific to certain kinds of foods. However, it limited biases in reporting as a result of seasonal variations in food production and consumption patterns and the fact that the 24 hours recall was unquantifiable, there was limited biases in the estimation of portion sizes that were consumed.

On the contrary, the 24 hours recall relied heavily on the ability of the child to remember the food items they had consumed from the time they woke up to the time they went to bed. This introduced a recall bias into the study findings and perhaps some foods were left out during the dietary analysis because a child can easily forget since twenty four hours is a long time for a child to remember all that they ate. A food frequency questionnaire or dietary records could have been used since these do not rely on the ability of the respondent to memorise the foods eaten.

Measurements of dietary diversity were carried out by counting each of the individual food groups from which the reported food items of the 24 hour recall were obtained. A score of ≤ 4 meant low diversity whereas a score of nine indicated a varied diet. A varied diet is meant to provide all the essential and non essential nutrients needed in the body for proper growth and development. The dietary diversity among the school children improved from baseline in the

control arm (4.54 to 4.83) and in the intervention arm (4.55 to 4.91) and were statistically significant.

The consumption of Vitamin A rich foods and vegetables, fats and oils increased in more than 10% of the children in both the control and intervention arms during the intervention period. In intervention schools, 49% of the learners had a dietary diversity score of ≤ 4 in 2009 which increased to 79% in 2010 and decreased again to 36% in 2011. This decrease in 2011 was a positive outcome in the study findings as the pupils' diets increased in variability. On the contrary, the children in the control arm reported a rather constant low dietary diversity score of ≤ 4 throughout the three years of the intervention. This meant that majority of the children consumed less varied diets obtained from mainly four food groups and these included meats, fats, oils and dairy whereas fruits, vegetables, eggs and legumes were least eaten.

The low consumption of fruits, vegetables, legumes, eggs presents a situation of low micro and macro nutrient intake by the children which hampers learning and cognitive development at large. The study findings further showed that most of the snack foods consumed included crisps, fried foods, sweets and carbonated beverages mainly sold in school canteens and around the school fence and gate. This underscores the fact that schools lack strong policies pertaining the type and quality of foods sold to the children by the vendors.

The study results also indicated that there was an increase in the consumption of sugars among the children in the control arm (0.35 to 0.38) in 2010 and 2011 respectively. On the other hand, the children in the intervention arm showed a reduced intake of sugars (0.13 to 0.11) in 2010

and 2011 respectively. This was attributed to the nutrition knowledge gained as a result of the intervention. Excessive intake of sugars is known to be a risk factor for Diabetes and Obesity.

The authors reported that the study was “disappointing” in terms of improvement in quality of the diet for the children. This was because the study results showed improvements in dietary diversity and the general quality of children’s diets although not statistically significant. The failure in study results was attributed to the nature of action planning process that was undertaken by the schools. It was evident that many schools planned activities, but did not fully execute them. For instance, only 20/ 30 nutrition events and 7/ 27 physical activity events were carried out by the schools. In addition, only two nutrition education activities were undertaken in all the eight intervention schools over the entire period of three years.

Furthermore, the purposive sampling of districts in the Western Cape whose schools were from the lowest three social economic profiles could have had confounders in the study results. Most of the people and schools from low economic status do not place great emphasis on non communicable diseases since they do not see them as directly inflicting on the child’s health and nutrition status. Coupled with the fact that a number of these children have little influence in the nature of food chosen, they are faced with under nutrition as compared to over nutrition.

The study reported that the low implementation of the action plans was due to the fact that the schools were responsible for implementing their nutrition actions. The study also showed that capacity building among teachers is not an easy task although very feasible. However the disappointing results of the Health Kick intervention were attributed to teachers yet there was poor Monitoring and Evaluation from the intervention team. Therefore, the failures are

attributed to poor monitoring of the activities by the Health Kick team. If they had been more efficient in monitoring the implementation, the activities could have been carried out smoothly. In contrast, this was a good approach from a Health Promotion point of view since it facilitates empowerment of teachers as the school champions.

The study continued to highlight the primary role that can be played by teachers in implementing nutrition interventions in schools. The findings of the study further underscore the need to intervene with teachers and educators not because of their potential role as change agents in primary schools, but also because of their generally poor health and nutrition status. In case the teachers are not healthy, they can be bad role models for the children to emulate. Therefore, the study should have included Health Promotion activities for school teachers during the action planning process. The study recommended that schools need to strengthen health and nutrition policies so as to create an enabling environment for healthy eating. In summary, the intervention improved the learners' diets in the intervention arm more than in the control arm although not statistically significant.

Study II: Promotion of Nutrition Education interventions in rural and urban Primary schools in Machakos District, Kenya (Mbithe et al, 2008)

Mbithe et al (2008) carried out a nine months nutrition intervention in two experimental and two control schools selected from rural and urban setup. The purpose of this quasi-experimental study was to address the gap in nutrition knowledge that existed among primary school children in Machakos district- Kenya, using community based participatory approaches. The study was preceded by a baseline survey conducted among 350 pupils of classes 5 and 6 in 15 out of 23 schools in the district. The baseline study showed that disease prevalence was high among the children, poor nutrition practices, low ownership of granaries, which is an indicator of post harvest losses and house hold food insecurity. The children in these classes were selected because they are in a pole position to transfer nutrition knowledge learned at school to the community. The control arm consisted of 169 pupils and the experimental arm consisted of 161 pupils.

The district was purposively selected because it had high levels of malnutrition and poverty. The intervention and control schools too, were purposively selected. Unfortunately, this un-random sampling introduces confounders especially when measuring dietary diversity and food choices. Most of the children from poor households are constrained in terms of food choices since they are unable to afford purchase of food. However, the study matched schools in terms of indicators such that these biases would be minimised.

The criteria for the selection of schools was well documented that schools to be selected for inclusion had to have equal acreage for school gardening, water facilities, adequate latrines and

the study ensured that the schools were located at least seven kilometres apart. This distance was necessary to prevent contamination of study participants through sharing of intervention knowledge among pupils. Despite this measure against contamination, it is not clear whether this prevented sharing of knowledge and information at home especially among the children in the same household.

The study measured pre and post to find out the effect of the effect of the intervention on the nutrition knowledge. The study used structured questionnaires and focus group discussions for data collection about the effect of the intervention on nutrition knowledge of deficiency diseases, nutritive value of food, hygiene, food safety, cooking methods, food choices, food preservation and recipe development. The intervention spread over two school terms and it was provided in a classroom setup. There was an allocated time during the school teaching timetable for the nutrition demonstrations.

The lesson plans used in the study were adapted and adopted to the context of schools in Machakos- Kenya and they were pretested as required. They were designed following guidelines from Food and Agriculture Organisation and Kenya Institute of Education. This ensured consistency of study results since they had reliability from the guidelines. However, there was no explicit explanation about the other study tools used in the study for data collection. Statistical significance was determined at 95% Confidence Interval and with a P-value of <0.05 . The researcher and one research assistant taught the nutrition education and administered the questionnaires. Teachers supported this process by grouping the pupils into

working strata of mixed abilities and sexes. This perhaps was to facilitate learning between students since they have different learning abilities.

Anthropometric measurements to assess the nutrition status of children used Weight for Height (WFH) index controlled for age and sex. This was appropriate although it would have been better if it had been integrated with Mid Upper Arm Circumference (MUAC). Both WFH and MUAC should have been used since there is no gold standard tool that is recommended for nutrition status assessment.

The study sought relevant research permits from Kenyatta University and the Kenyan Ministry of Education. This was coupled with consent and ascent sought from parents and pupils respectively. The study measured dietary diversity, sanitation and disease pattern, school attendance, teachers, parents and pupils perception towards nutrition education, nutrition knowledge, food consumption patterns and nutrition status of pupils and the long term effects of the intervention.

Results of the study showed that nutrition knowledge among the school children improved significantly among the experimental schools than in the control schools ($P < 0.05$). Underweight reduced from 14.5% to 11.8%, stunting reduced from 28.9% to 21% and wasting reduced from 3.9% to 2.6% although not statistically significant. The reduction in the levels of stunting from 28.9% to 21% is rather questionable in just nine months of the intervention since stunting is as a result of chronic deprivation hence cannot be easily corrected in a short time especially after five years of age. Results of stunting are best obtained after longitudinal studies with longer

length of follow up. The statically significant change was the increase in nutrition knowledge among children in the experimental arm ($P < 0.05$)

In terms of gardening, rural experimental schools did better ($P < 0.05$) than the urban schools in terms of crop yields yet they all had same amount of land for farming and this result was statistically significant. This was perhaps attributed to attitude towards agriculture that prevails among the rural versus the urban settings and the fact that rural children practice farming more than the children from the urban setup.

The study demonstrated that nutrition education is much more sustainable than interventions such as physical food distribution. Thus, it is imperative to empower people and communities to produce their own food than giving them food aid. The communities are able to cultivate their food if they are taught, provided with equipment and in a supportive enabling environment. The study results further showed that school attendances improved tremendously at the end of the intervention because of the reduction in levels of illnesses.

The study also showed that children are effective change agents in both schools and the community since they represent many households and thus strengthen the community- school interaction. The children were able to transfer knowledge and new crops from school to home which the community adopted. The crops included bush okra, spider plant and sweet potato leaves which are viable sources of vitamins and minerals. This underscores the fact that nutrition education is one of the developmental investments that governments in Sub Saharan Africa should embrace in the fight against the determinants of over and under nutrition.

The study showed that there was improvement in the nutrition knowledge and practices among experimental schools as compared to the control schools. This was evidenced by 48% of parents who reported changes in their children like washing vegetables before cooking. The parents too reported changes in children's food selection, preparation, consumption and preservation attributed to the nutrition knowledge obtained. Therefore, nutrition education in schools can have long lasting effects not only to the children, but the community at large hence the lack of nutrition knowledge ought to be addressed when tackling the diverse determinants of malnutrition.

Results from the study showed that nearly all pupils (95.7%), head teachers (15) and class teachers (30) recognised the never ending need for nutrition education in primary schools. Furthermore, a focus group discussion with parents reported that the current primary school teachers are not knowledgeable in nutrition and therefore need to be trained so that they can competently offer the nutrition education to the children. This further stresses the need for strengthening nutrition education in schools.

Changes in the feeding practices among pupils and their households demonstrate the effectiveness of the intervention in improving the nutrition status of children. Fruits and vegetable intake increased owing to the nutrition knowledge obtained. The study further showed that school gardens offer an inexpensive and simple practical approach to nutrition education.

The study recommended that time spent at school should be put to maximum utilisation by well trained teachers that act as role models to the children. The teachers are able to instil

appropriate feeding practices and nutrition habits among the children that can be carried on to adulthood. Nutrition education among primary school curriculums need to be strengthened and widened so as to contribute to the improvement of the nutrition status of children.

The study did not randomise the participants, and did not explicitly describe the method of recruitment of study participants and did not account for withdraws and drop outs as it should be the case with experimental studies. This meant that imputation of missing data was made hence introduced attrition bias in the study results. The study ran from May to December 2005 which makes eight months yet the report mentioned nine months of the intervention. The authors did not declare any funders and conflict of interest though an email and contacts of the author were given for further correspondence.

Study III: Nutrition knowledge and food choices of primary school pupils in the Niger- Delta Region Nigeria (Eboh and Boye, 2006)

A quasi experimental cluster study by Eboh and Boye (2006) evaluating the effect of a three weeks nutrition education program on nutrition knowledge and healthy food choices of 197 primary six pupils who were randomly allocated to control (n= 102) and experimental arm (n= 95). The intervention consisted of nutrition education that lasted 40 minutes and was conducted for three days a week for three weeks. A 25 multiple choice pre and post questionnaire was administered to assess nutrition knowledge scores and a three days' food record was used to carry out dietary intake analysis to evaluate the food choices of the children before and after the intervention in relation to the recommended daily allowances and the food guide pyramid.

Results of the study showed that the children in the intervention arm were slightly lighter in terms of body weight and performed better in terms of food choices and nutrition knowledge as compared to the control arm. There was a greater increase in mean scores of nutrition knowledge among the experimental group from 10.8 ± 2.7 to 14.6 ± 2.7 (59%) as compared to the control arm 10.1 ± 2.5 to 10.1 ± 2.2 (4.1%), positive changes in reduction of meat servings (-2.1), fats, oils and sweets (-0.7) whereas the control group showed an increase in the intake of meat (+1.1), fats, oils and sweets (+0.4). Food records of children in the intervention arm showed an increase in the intake of grains (+1.15), fruits (+0.6), milk (+0.6) and vegetables (+0.3) whereas the control arm showed a decrease in the intake of grains (-1.0), fruits (-1.4) and vegetables (-1.1).

Other results showed that the experimental arm met the recommended servings of foods in terms of portion sizes as compared to the control arm although the servings of fruits and vegetables did not meet the recommended daily allowances. The study showed that structured education sessions in form of lectures and unstructured approaches such as games, role plays, songs, drama and hands on activities by teachers can have a profound effect on the nutrition status of children in schools. It also showed that the food guide pyramid is a good instruction tool that can support the efforts of teachers in delivering nutrition education to pupils.

Despite the fact that the study showed the effectiveness of a nutrition education program on nutrition knowledge and food choices, it had pitfalls. The use of three days' food records to assess the dietary intake of pupils was not appropriate since a child can easily forget to record the food eaten and in its rightful portion size. Three days' food records are not representative of usual intake. In an event where a comprehensive dietary intake needs to be assessed, it requires at least seven days. Therefore, three days were a short time to carry out dietary assessment.

The researchers administered the research protocol and taught the curriculum with a view of minimising the subjectivism, effects of personality and background among teachers. Although, it ensured consistency in terms of delivery of the intervention, teachers were not fully empowered to carry on with the intervention. This hampered the sustainability of the program since teachers have more time with the pupils on a day to day basis. Teachers should have had a much more active role in the implementation of the intervention than what they had.

The recommended daily allowances focused on macro nutrients (Carbohydrates, Proteins and Fats). The study boasted of an increase in the intake of proteins and carbohydrates among the children in the intervention arm although this too, presents a dilemma. Increase in the intake of carbohydrates has showed increased risks to non communicable diseases (Fanzo, 2012) such as obesity and diabetes. The study should have focused on micro nutrients such as Vitamin A or Iron since school children tend to have a low intake of fruits and vegetables (Sherman & Muehlhoff, 2007) which predisposes them to micro nutrient deficiencies.

The allocation of study participants to either control or intervention arm was not explicitly explained coupled with purposive sampling of schools. This could have caused bias in the allocation sequence. The study did not account for drop outs in either arms and this could have brought in attrition bias into the findings of the study. There was no reported follow up after the intervention period of three weeks to ascertain the behaviour change among the primary school children. Follow up is paramount in any intervention study to measure the long term effect of the intervention.

Blinding of study participants was not possible since this was an open label intervention where the researchers and the pupils could openly see the intervention. The risk of this was the contamination effect that could have happened either at home or through conversations among peers. Since two schools were purposively selected from each area, no measure was in place to prevent contamination and sharing of knowledge learnt at school.

The research was involving children as main participants thus it was essential for the researchers to state how they engaged, sought for children's consent and the approval.

Unfortunately, the study did not highlight whether the researchers obtained ethical approval from either the University board or the schools administration before undertaking the study. Consent from the parents of children was not sought or even ascent from the pupils before administering the questionnaires. This was against ethical values of any research study. Perhaps the researchers sought for approval or ascent although it was not reflected in the published report.

The control group did not receive the intervention after the study period yet the findings proved effective in terms of improvement of nutrition status. This was unethical since intervention studies have to give the intervention to the control arm after the study period in case the results show that it is effective.

The study did not have a clear theoretical underpinning yet Health Promotion is a theory laden discipline (Healey and Zimmerman, 2010). Studies need to be carried out in relation to Health Promotion theories, models or research paradigms. In addition, the abstract indicated four days a week of nutrition education whereas the methods section of the article indicated three days a week of nutrition education to the grade six pupils. This showed inconsistency in the data and information presented. There was no conflict of interest declared and the funding sources too were not disclosed. The correspondence required for further study information was also not given.

Despite these pitfalls, the study had positives such as matching of participants. The children were ethnically homogeneous, the schools had similar social economic status and the parents

of children in the schools were middle income earners. This was a good control measure against confounders since there was no randomisation of study participants.

The tool used to assess the nutrition knowledge had an acceptable internal consistency (0.74) of Cronbach's alpha coefficient since it increases as inter correlations among test items increase. The tool was pretested with 30 primary six pupils and this ensured reliability. Validity of the tool was assessed by experts in nutrition and this meant that the tool had both internal and external validity.

The nutrition education focused on topics of paramount importance to children such as food guide pyramid, food portion sizes and number of servings, food choices and functions of macro nutrients, preparation and food labels of healthy snacks, types of food and benefits of vegetarianism. This wholesome package allowed for a comprehensive nutrition education to the children although the quality of the delivery is questionable. How was it possible to cover all these topics in 40 minutes of nutrition education three days a week for three weeks?

The study findings showed an increase in dietary diversity of children in the intervention arm in terms of food groups as per the food guide pyramid. Unfortunately, the increase in the consumption of fruits and vegetables was below the recommended daily allowances. The study demonstrated that teacher- based interventions in schools can have an effect on the nutrition status of children since interventions at formative stages of growth and development carry with them lifelong changes to dietary habits (World Health Organisation, 2013).

3.5 Synthesis of Results

3.5.1 Meta analysis

The quantitative synthesis was undertaken to calculate the effect sizes of pooled studies by use of comprehensive Meta analysis Version three. The results are presented as below:

Statistical Forest plot

The forest plot is a graphical display illustrating the relative strength of study effects. The figure below shows weighted average of all the three pooled studies standardised mean differences of the main outcomes of pooled studies (Eboh and Boye, 2006; Mbithe et al, 2008; Steyn et al, 2015)

Effect of Teacher- Based Interventions

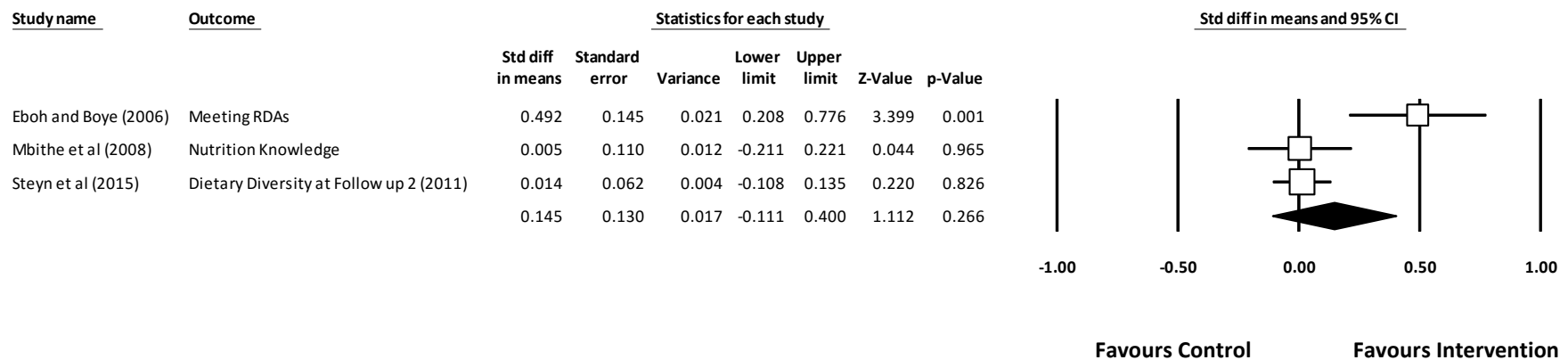


Figure 2 showing forest plot

The squares represent the point estimates of each study and are of different sizes because of the differences in study weights in terms of sample sizes and variance. The diamond is the pooled summary effect and it is evident that the interventions favour the outcomes of improved dietary diversity, nutrition knowledge positively. The effect is however not so strong (0.145) at 95% CI. The mean differences between the control and intervention arms were used to estimate the pooled standardised mean difference in weight gained between intervention and control groups, using a random effects model to account for variance in study design and outcome variables. This was used because the reviewer assumed that the true effects in the individual studies may be different from each other due to differing study designs and populations. The random effects model provided a weighted average to individual studies since larger sample sizes decrease variability and increase precision.

Hedge's G

Effect of Teacher- Based Interventions

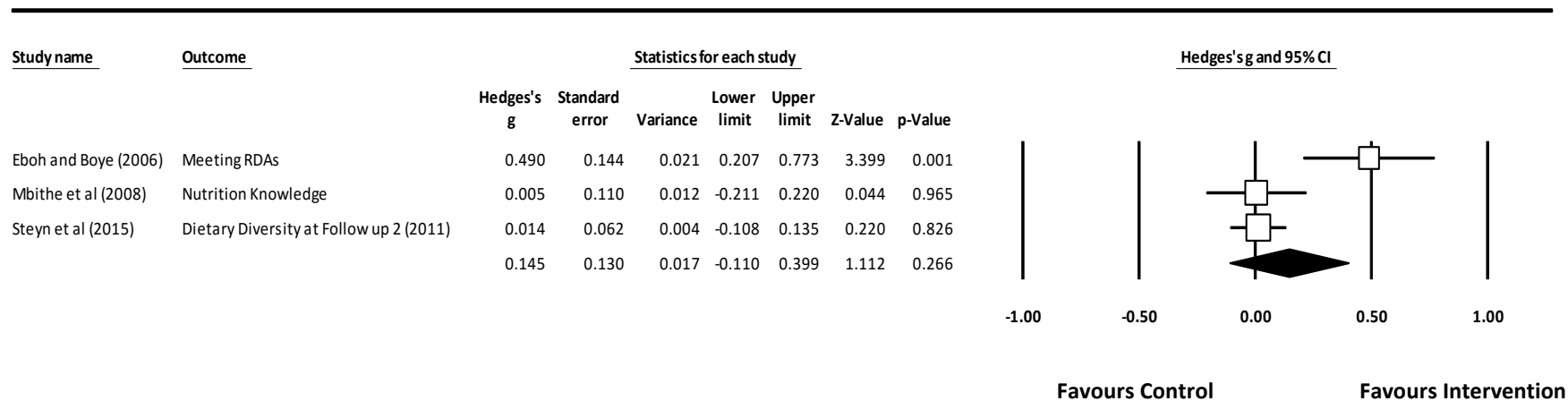


Figure 3 showing Hedges' G Statistic

In order to correct the effect of sample size on the effect measure, a hedge's G statistic was calculated where by the standardised mean difference is divided by the pooled standard deviation. The random effects model yielded a pooled Hedges G= 0.145 (95% CI - 0.110- 0.399) showing a positive effect although not so strong. This perhaps could have been caused by the flaws in the included studies. The positive direction of Hedges G also point to the fact that the interventions favoured the outcomes.

Heterogeneity

Since this review brought together three studies that were carried out by different people in different settings and different lengths of time, there was need to calculate heterogeneity. Statistical heterogeneity between trials was assessed using the I^2 statistic. I^2 is the proportion of observed variance reflecting real differences in the effect sizes. The Cochrane I^2 interpretation used in this review was 25- <50 Low heterogeneity, 50- < 75% moderate while >75% high heterogeneity. From the table below, the I^2 is 79.315 showing a high heterogeneity among the studies owing to the different designs.

Table 5 showing heterogeneity statistics

Effect Size and 95% Confidence Interval						Test of Null (2- tail)		Heterogeneity			
Number of studies	Point Estimate	Standard Error	Variance	Lower Limit	Upper Limit	Z- Value	P- Value	Q- Value	Df (Q)	p- Value	I^2
3	0.145	0.130	0.017	-0.110	0.399	1.122	0.266	9.669	2	0.008	79.315

In reference to the Hedges' G forest plot, the lines indicating the confidence intervals do not overlap each other and this shows that there is heterogeneity among the studies hence the study results showed a high level of variability. In addition, Cochran's Q, which is calculated as the weighted sum of squared differences between individual study effects and the pooled effect across studies, was above zero showing a high degree of heterogeneity. If $(Q - df) \leq 0$, there is no heterogeneity while if $(Q - df) \geq 0$, then there is study variability. In this study, $(Q - df) = 6.901$ showing a high degree of variability.

Sensitivity Analysis

A sensitivity analysis was performed by removing one study and the resulting effect did not change the overall effect. The pooled estimate still remained > 0 showing that the interventions still favoured the outcome positively.

However, conducting a Meta-analysis did not overcome problems and challenges that were in the design and execution of the included primary studies. The included studies had their own pitfalls such as lack of randomisation of study participants and the duration of interventions.

3.5.2. Qualitative Narrative analysis

This was undertaken in relation to the Barnfenbrenner's Ecological Systems theory constructs. The teachers are part of the child's Meso and Micro systems that affect food choices, quality of food eaten and physical activity levels. The Meso and Micro systems comprise of the intrapersonal, interpersonal, organisation and community levels as discussed below:

Individual/ Intrapersonal

Findings from Eboh and Boye (2006), Mbithe et al (2008) and Steyn et al (2015) indicate that the factors inherent to a child have the potential to affect their nutrition status and they include the diet eaten, food choices, food habits and nutrition knowledge of the child. In view of the fact that teachers stay with the children on a day to day basis, they have an opportunity to influence these factors positively. Through nutrition education, they are able to improve on the nutrition knowledge of the children, foster improved food choices and encourage good food habits. Only when these intrapersonal factors are enhanced that a child will begin making informed decisions about food. This can lead to good nutrition practices in childhood which can be taken over to adulthood and the next generation. Therefore, Nutrition education and knowledge acquisition has been showed to have a significant contribution towards healthy food choices. This calls for an integration of nutrition into the overall school health programming.

Interpersonal

Results of Mbithe et al (2008) showed that it is of paramount importance to involve parents and guardians as part of a comprehensive school nutrition program. This is because the parents are responsible for food provision and preparation when the children are at home. If they have sound nutrition knowledge, then they will be able to provide the best nutritious foods for the children.

Parents have a strong influence on the type of food prepared at home and the food preparation process. When parents foster good hygienic practices, the children are able to exercise all that they have learnt from their parents. Studies by Steyn et al (2015) and Mbithe et al (2008)

integrated parents into the school based nutrition intervention and they were instrumental in the success of the intervention. The parents encouraged the children to adopt healthy nutrition lifestyles and they also advocated for improved nutrition programming in schools. They were able to report that the current group of teachers needed better nutrition training and capacity building if they are to implement successful nutrition programs in schools. The community on the other hand was seen selling junk food to the children around school gates and so the entire community that nurtures school children need to be integrated into the wide nutrition programming so as to have high impact sustainable nutrition interventions.

Organisation

In this case, the organisation refers to schools. These offer suitable environments and mechanisms for promoting and fostering teacher- based nutrition interventions since they offer effective, efficient and an equal opportunities atmosphere to influence dietary habits. Findings from Eboh and Boye (2006) showed that these interventions reach the children when they are at formative stage of growth. At this stage, food habits and choices are developed and these have the potential to be carried on for life.

Steyn et al (2015) indicated that teachers were able to implement the nutrition curriculum as part of the academic curriculum. Despite the poor results obtained in the Health Kick intervention, other studies need to be carried out with the same methodology of leaving every detail of the implementation process in the hands of teachers, but rather strengthen the monitoring and evaluation process. Teachers were also observed to be very active in the establishment of school gardens that provide extra food for the school and also act as learning

sites for practical nutrition and Agriculture. A similar study by Parmer et al (2009) found out that the participants in the Nutrition Education and gardening and treatment groups exhibited significantly greater improvements in nutrition knowledge and taste preferences than the children in the control group. This underscores the fact that school gardens as a component of nutrition education can facilitate proper Nutrition Education sessions and also bring about behaviour change among school children.

Community Level

Teacher- based nutrition interventions in schools also benefit the entire community. As evidenced in Mbithe et al (2008), the intervention children were able to transfer new crops from school to home and these included bush okra, spider plant and sweet potato leaves which are viable sources of vitamins and minerals.

Since malnutrition is caused by a myriad of factors, it is therefore important to address its wide determinants. Among these is food insecurity, poverty levels and social norms. The community based factors such as poverty levels and house hold food insecurity have to be addressed if Sub Saharan Africa is to have a hungry free generation. Lessons learnt from Mbithe et al (2008) study included the fact that school based nutrition interventions have the potential to improve the food security situations at community levels through adoption of new crops. In addition, interventions that involve the entire community have showed that they are sustainable that even when the implementers phase out, the community is able to carry on with the intervention.

CHAPTER FOUR: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

4.1 Discussion

In reference to the Briss et al (2000) assessment tool (Appendix X) about the strength of a body of evidence on effectiveness of population-based interventions, the synthesised body of evidence is insufficient. This is because the studies were only three of which two were of insufficient designs, had some inconsistencies and the overall effect size is small. Despite the shortage of robust studies, it is clear that nutrition interventions in schools play a great role in the improvement of nutrition and health status of primary school children in Sub Saharan Africa. Therefore teacher- based interventions should be adopted in Sub Saharan Africa as a new integrated approach in addressing chronic Malnutrition that is rooted in Sub Saharan Africa.

Findings from Steyn et al (2015), Eboh & Boye (2006) and Mbithe et al (2008) pointed to adoption of community based participatory approaches that actively involve and empower all stakeholders such as school children, teachers, parents and the entire community. Mbithe et al (2008) further reported adoption of new crops from school gardens to the community. This was so because school children are effective change agents. Therefore teacher- based nutrition interventions in schools have the potential to reach out to the entire community which makes them sustainable.

Eboh & Boye (2006) reported that structured curriculum in form of nutrition education in a classroom setup and unstructured approaches such as drama, songs and role plays have the potential to influence the nutrition knowledge and behaviours of school children. These

interventions however, cannot be implemented successfully if teachers lack sound knowledge and capacity. Steyn et al (2015) provided teachers with training materials as a way of capacity building teachers in terms of service delivery. However, the study reported low execution of action plans with only two nutrition education sessions taking place in three years. This therefore pointed to poor monitoring and evaluation by the intervention team. Therefore empowerment, training and capacity building of teachers in nutrition should be followed up with adequate support supervision for successful nutrition interventions. As outlined in chapter two, the discussion section further follows the four outcomes of interest as discussed below:

Nutrition Status

Teacher- based interventions demonstrated that they are effective in the improvement of nutrition status of children. Mbithe et al (2008) resulted in the reduction of underweight, stunting and wasting and similar results were evidenced in Eboh and Boye (2006). The interventions resulted in an increase in nutrition knowledge of children which was transferred into adoption of healthy nutrition practices. Similarly, Steyn et al (2015) reported an improvement (36%) in the dietary diversity of children in the intervention arm.

These results were similar to Neervoort et al (2013), Rosario et al (2013), Oosthuizen et al (2011) and Neumann et al (2013) who further provide more evidence about the roles that teachers play in the improvement of malnutrition among school children. Therefore, teacher-based interventions have the potential to improve the nutrition status of school children if successfully implemented.

The three studies Steyn et al (2015), Eboh & Boye (2006) and Mbithe et al (2008) demonstrated the need for teachers to have their Health Promotion activities so as to maintain a healthy body and lifestyle. Bandura's (1986) social learning theory recognises the significant opportunity that presents with teachers if they are the right role models. School children are able to emulate them and apply the same lifestyles, knowledge and skills for their own growth and development.

Sustainability

Results from the reviewed studies showed that teacher- based interventions are sustainable if implemented. In the Mbithe et al (2008) study, new crops were transferred to the community after the intervention period. This showed continuity of the intervention and these crops the community adopted are good sources of nutrients to promote better nutrition status and improve house hold food security.

This further underscores the need to change the way nutrition programming has been streamlined mainly through the health sector by integrating teachers and the education sector to fuel and implement nutrition interventions in schools. Lessons from Steyn et al (2015) showed that teachers were able to deliver nutrition interventions when they received adequate training and empowerment. However, the training should be accompanied with adequate monitoring and evaluation as a way of support supervision. This will facilitate smooth implementation of interventions among the school children.

Participation

Eboh and Boye (2006), Mbithe et al (2008) and Steyn et al (2015) showed that teacher- based nutrition interventions have the potential to improve school attendance. This is because proper nutrition fosters better health hence certain illnesses that would otherwise make pupils miss school due to sickness are avoided. In an event where schools have cooking demonstrations, children attend school better because they do not want to miss out on the food that is prepared (Mbithe et al, 2008). Furthermore, these programs target large numbers of children like in Steyn et al (2015), the control arm had 498 children while the intervention arm had 500 children while in Mbithe et al (2008), there were 161 and 169 children in experimental and control arms respectively. All these children are reached by an intervention at the same time and this makes teacher- based interventions very cost effective.

Cost- Benefit Analysis

Since teacher- based nutrition interventions reach very many children at the same time, they are cost effective. The health kick intervention by Steyn et al (2015), built the capacity of teachers so that they could implement the intervention by themselves rather than use of external facilitators. This was geared towards having high impact low cost intervention. Therefore, if teachers are trained adequately and empowered to execute nutrition activities in schools, a lot of resources that would otherwise have been utilised to facilitate external personnel would be saved. This also ensures sustainability of the intervention.

External facilitators like schools pose many challenges to both the schools and the education ministries in terms of cost. This therefore calls for a change of approach such that school teachers are integrated actively in nutrition activities, their capacities built through training, refresher trainings, on the job mentorship and adequately supported to carry on with the implementation of activities in a conducive environment.

4.2 Conclusion

Despite their importance, teachers have not been given due emphasis in Sub Saharan Africa. There is an urgent call to make a case for teacher- based nutrition interventions in schools in Sub Saharan Africa. In order to break the rooted life cycle of malnutrition, there is need to make school based nutrition interventions national priorities. All stakeholders including teachers, school leaders, community leaders and parents must come on board and commit to implementing and sustaining nutrition programs within the schools by redesigning the national formal and informal Primary school curriculums.

Adequate nutrition is an important pillar of any thriving nation especially in Sub Saharan Africa. Therefore the roles of teachers and health personnel should be explicitly defined to avoid conflicts. The health professionals should continue implementing their secondary roles of treatment and provision of curative regimens whereas teachers can be adequately used in the primordial and primary prevention stages of malnutrition. Through these interventions, we shall be able to achieve a Sub Saharan Africa where *'Every child has a right to adequate food and nutrition, the invisible have to be given visibility and opportunity to fulfil their potential'*

4.2.1 Lessons learnt

Teachers in schools have a potential platform upon which to influence learners' nutrition behaviours. Through the provision of nutrition knowledge and skills to learners, it has the potential to reduce nutrition-related diseases in both the childhood stages and later in adulthood. Their understanding and recognition of this responsibility is a huge step in the process of raising a healthy generation of African children. Teachers however need to be supported, encouraged and equipped with sound nutrition knowledge to facilitate a smooth nutrition education delivery process.

Nutrition interventions improve children's health and nutrition status, learning potential and school attendances. Primary school children are at a stage of rapid growth and development where adequate nutrition is very important for consistent nutrient supply. Therefore there is need to offer nutrition training and supervision to teachers. All stakeholders need to support teachers and schools in the implementation of various nutrition interventions.

There is need to balance autonomy and supervision if programs are to be a success and sustainable. Just as in the Health Kick intervention by Steyn et al (2015), there was autonomy given to teachers although there was no proper and adequate supervision of teachers which resulted into disappointing results.

The health messages developed need to be in line with the dietary guidelines and they should be easy to be memorised and understood. Steyn et al (2015) used messages such as *"Eat a variety of foods everyday"* and *"eat many different types of fruits and vegetables every day"*.

“Eat less sugar and sweet foods such as cakes, doughnuts and sweets”. The messages should be tailored to the cultural context of any given place. This will ensure consistent uptake of the health and nutrition message so as to cause a change in dietary behaviours.

4.2.2 Research gaps Identified

There is a shortage of high quality Randomised Controlled Trials that study the effectiveness or the impact of teachers in the implementation of school nutrition activities such as supplementation programs and school gardening in Sub Saharan Africa. Whereas there are many studies about teacher- based interventions across the World, there is not much that has been carried out in Sub Saharan Africa. Most of the studies carried out have used external facilitators such as nutritionists, dieticians and other health personnel to carry out the intervention in schools while teachers take up passive roles.

New research needs to be carried out with teachers actively involved in the entire process of the intervention and these should be experimental studies. It is not until teachers and the education sector are empowered to carry out primordial prevention strategies that we shall reduce on the high numbers of malnourished school children in Sub Saharan Africa.

At the moment, teachers are not making the best of their potential opportunities for the prevention of malnutrition therefore a study about the willingness, knowledge and attitude of school educators must be considered and an investigation of potential adverse effects of school interventions on the academic performance of school children. There is need to explicitly examine the cost-effectiveness of teacher- based nutrition interventions through a

comprehensive cost benefit analysis process using interventions with extended follow up period.

4.2.3 Limitations of the study

This review included both Randomised Controlled Trials and the Quasi Experimental studies which are not as robust as the former because they lack randomisation. In (Eboh and Boye, 2006; Mbithe et al, 2008) studies, no follow up was made yet nutrition interventions in schools require time to measure their effects and impact since behaviour change is a slow process. This review also limited articles to only those published in English and in different countries of Sub Saharan Africa. This perhaps might have limited the number of eligible studies for inclusion.

4.3 Recommendations for Practice

These have been classified according to Governments and National Ministries of Education, Health and Schools as discussed below:

4.3.1: Recommendations to Governments and National Ministries of Education and Health

The Ministries of Education in Sub Saharan countries should integrate nutrition in the overall school curriculum. This therefore calls for the implementation of nutrition activities from primary schools throughout secondary level of education designed to enhance and support the pupils adopt a healthy nutrition lifestyle for a lifetime. There is need to revise National Curriculums for both teachers at training colleges at primary education level so as to integrate nutrition aspects.

In addition, Nutrition education should be part of a comprehensive health education curriculum that emphasises the wholesome nature of health. However, there is need to provide nutrition activities and skills through culturally relevant, fun and full participatory approaches that involve social learning. This is because pupils from different cultural groups have different health concerns, food habits, eating patterns and food preferences.

Ministries of Education and Health should monitor nutrition as an essential component of education since nutrition, health and education are strongly interlinked. In addition, governments should increase the budget allocation to school nutrition activities since there is limited funding for nutrition activities which undermines efforts to improve the nutrition status of children.

Ministries of Health, Ministries of Education and International Developmental Partners should strengthen program evaluation to test the effectiveness of the school nutrition programs in promoting healthy eating to increase its effectiveness. This calls for engaging health and education officials, teachers and all concerned stakeholders entirely in the program management cycle.

Teachers should be provided with adequate pre service and ongoing in-service training since the nutrition training that they receive is hugely dependent of the subject of specialisation. Teachers should be trained on identifying visible clinical signs of malnutrition, deficiency diseases, classifying different food groups and their nutrient content. The training should facilitate improvement in the health and nutrition practices of teachers such that they carry with them, the right message as role models to the school children.

4.3.2: Recommendations to Schools

Schools in Sub Saharan Africa should adopt a coordinated school nutrition policy that promotes healthy eating through classroom lessons and a supportive school environment. This can be enhanced by school principles, directors and teachers. This policy can direct the kind of foods sold around school premises, canteens and enhance physical activity levels which would promote health and nutrition among the school children. School leaders and teachers should develop a policy that prohibits the use of physical activity as a form of punishment.

Pupils should be integrated into school food service such as school kitchens and school restaurants such that they acquire a practical touch as far as food preparation is concerned. Through this process, nutrition education can be integrated to re- enforce message delivery. The school kitchen and dining hall provides a platform and an opportunity for school children to practice healthy eating through planning menus and food preparation. The kitchen staff should also be integrated in explaining to school children how they prepare food and why certain foods are selected while the children can have practical sessions about food preparation and planning menus.

Schools should foster a strong family and community involvement since nutrition is a multi sectoral concern that cannot be achieved by one person thus it is necessary to involve parents and the entire community. If the parents are equipped with the relevant nutrition knowledge, they have the capacity to pass it on to the pupils or reinforce what is taught at school by teachers. In addition, parents control most of the food choices available at home, so changing

parents' eating behaviours and improving their nutrition knowledge is an effective way to change school children's food habits at home.

Teachers in primary schools have to maximize classroom time promptly. This could be through nutrition education and integrating nutrition into other subjects for instance English reading or comprehension could use nutrition related passages and ask similar questions from the passages, Mathematics lessons could also use nutrition related additions and subtractions. Through this, children will be able to grasp the science of nutrition that will aid in their development as children and also in the adulthood stages.

Schools need to integrate nutrition topics into school debates. This will ensure that the science of nutrition is grasped by the primary school children. Schools could also setup nutrition clubs where nutrition education can be carried out by designated teachers. Schools also need to set up nutrition committees to oversee all nutrition related activities in schools. These could be chaired by either the science teacher or any other volunteer from the school staff. These will be instrumental in the overall success of teacher- based nutrition interventions in Sub Saharan African Primary schools.

4.4 Policy implications

From the evidence as described, Sub Saharan countries need to adopt an alternative channel for primordial and primary prevention strategies for Malnutrition since they reach many children, cost effective, sustainable and have the potential to prevent and control Malnutrition. Teachers and the education sector should be integrated in the fight against Malnutrition.

However, they should receive adequate training, refresher courses, adequate supervision and be supported to implement various nutrition activities in schools. Governments in Sub Saharan Africa need to adopt this strategy as they try to meet the Sustainable Developmental Goals.

4.5 Reflection

This dissertation has highlighted the potential role that can be played by teachers and the education sector in the fight against Malnutrition in Sub Saharan Africa if adequately empowered and utilised. Despite the limited numbers of robust Randomised Controlled Studies in Sub Saharan Africa, It is clear that teacher- based nutrition interventions are cost effective, sustainable and reach many children that are enrolled in schools today. The major question that arises out of this study is how can Ministries of Health or Education in various countries roll out this approach?

It is necessary that each Sub Saharan country starts with pilot studies in various districts and the results of the evaluation can inform further roll out in the entire country. For countries that started implementing teacher based approaches, these should be strengthened and teachers supported better to implement the activities. This approach will reduce on the burden of childhood diseases that are fuelled by Malnutrition if it is controlled and prevented at the earliest time possible in schools.

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APPENDICES

APPENDIX I: DATABASES AND SEARCH ENGINES SEARCH STRATEGY

PubMed

Search	Add to builder	Query	Items found	Time
<u>#6</u>	<u>Add</u>	Search ((((((("School garden"[Title]) OR "Demonstration farm"[Title/Abstract]) OR "Demonstration garden"[Title/Abstract]) AND "Nutrition knowledge") AND "Malnutrition") AND "Nutrition status"[MeSH Major Topic]) AND "Child health"[MeSH Major Topic])	0	11:39:24
<u>#5</u>	<u>Add</u>	Search (((((((("school feeding") OR "school meals") OR "school lunch") AND "nutrition status"))	3	11:38:00
<u>#4</u>	<u>Add</u>	Search (((teacher nutrition interventions) OR teacher nutrition activities) AND nutrition status) AND child growth)	1	11:33:20
<u>#3</u>	<u>Add</u>	Search (((Nutrition Education[Title/Abstract]) AND Primary Schools in Africa) OR African Schools AND Malnutrition)	29	11:28:23
<u>#2</u>	<u>Add</u>	Search (((("Nutrition Education in schools"[Title]) OR "School feeding"[Title]) OR "School garden"[Title]) AND Nutrition status) AND School children	21	11:21:54
<u>#1</u>	<u>Add</u>	Search (((((((teacher led nutrition interventions) OR role of teachers in nutrition) OR (teachers and nutrition)) OR educators' nutrition interventions) AND nutrition status of children) OR wasting of children) OR children food choices) OR nutrition knowledge	19182	12:03:36

Note: The first search strategy was carried out on 7th July 2016 and the rest on 11th July 2016

BASE

Time	Search	Options	Results
10.07.2016, 17:59	<u>teacher nutrition</u> <u>activities continent:caf</u>	Additional word forms: On Boosting: Open access documents	26
10.07.2016, 17:56	<u>tit:teacher tit:nutrition</u> <u>tit:activities</u> <u>continent:caf</u>	Additional word forms: On Boosting: Open access documents	0
10.07.2016, 16:51	<u>tit:School tit:Feeding</u> <u>tit:School tit:lunch</u> <u>continent:caf year:[2000</u> <u>TO 2015] doctype:(12*</u> <u>14 18* 19 7 F)</u>	Additional word forms: On Boosting: Open access documents	0
10.07.2016, 16:49	<u>tit:school tit:garden</u> <u>primary school children</u> <u>continent:caf year:[2000</u> <u>TO 2015] doctype:(12*</u> <u>14 18* 19 7 F)</u>	Additional word forms: On Boosting: Open access documents	2
10.07.2016, 16:42	<u>tit:nutrition tit:education</u> <u>primary school children</u> <u>continent:caf year:[1990</u> <u>TO 2015] doctype:(12*</u> <u>14 18* 19 7 F)</u>	Additional word forms: On Boosting: Open access documents	5
06.06.2016, 15:01	<u>Teacher Nutrition</u> <u>interventions</u> <u>continent:caf year:[2000</u> <u>TO 2015] doctype:(0001</u> <u>0005)</u>	Additional word forms: On Boosting: Open access documents	7
06.06.2016, 15:00	<u>Teacher Nutrition</u> <u>interventions</u> <u>continent:caf year:[2000</u> <u>TO 2015] doctype:(0001</u> <u>0005)</u>	Additional word forms: On Boosting: Open access documents	7

Note: The search strategy was saved on 10th July 2016.

COCHRANE DATABASE SEARCH

"School nutrition interventions" in Title, Abstract, Keywords or "school nutrition activities" or "teacher led nutrition" or "school nutrition" and African Primary schools (Word variations have been searched) 11/07/2016 07:20 **There are 6/ 9463 results**

"School feeding" in Title, Abstract, Keywords or "lunch at school" or "school food" or "school meals" and African Primary schools (Word variations have been searched) 11/07/2016 07:15. **There are 13/ 9463 results**

"School gardens" in Title, Abstract, Keywords and "primary school" or "Africa" (Word variations have been searched) 11/07/2016 07:13. **There are 1227/ 9463 results**

"Nutrition education" in Title, Abstract, Keywords and "primary school" or "Africa" (Word variations have been searched) 11/07/2016 07:13. **There are 1228/ 9463 results**

"Nutrition education" in Title, Abstract, Keywords and "primary school" or "Africa" (Word variations have been searched). 11/07/2016 07:11. **There are 1228/ 9463 results**

"teacher led nutrition interventions in African schools" in Title, Abstract, Keywords or nutrition education in African primary schools in Title, Abstract, Keywords or School feeding in African primary schools in Title, Abstract, Keywords or Gardens in African primary schools in Title, Abstract, Keywords or role of African teachers in nutrition (Word variations have been searched) 02/07/2016 09:54. **There are 43/ 9463 results**

"teacher led nutrition interventions in African schools" in Title, Abstract, Keywords or nutrition education in African primary schools in Title, Abstract, Keywords or School feeding in African primary schools in Title, Abstract, Keywords or Gardens in African primary schools in Title, Abstract, Keywords or role of African teachers in nutrition (Word variations have been searched)

Last Saved: 02/07/2016 09:54:35.231 and **Results were 42.**

Teacher led nutrition interventions in African schools:ti,ab,kw or nutrition education in African primary schools:ti,ab,kw or School feeding in African primary schools:ti,ab,kw or Gardens in African primary schools:ti,ab,kw or role of African teachers in nutrition (Word variations have been searched) **Results were 42.**

Note: The search strategy was saved on 11th July, 2016 and can be retrieved.

GOOGLE SCHOLAR

"Nutrition education" OR "nutrition training" OR "Nutrition skills" AND "schools" OR "primary schools" OR "Africa" **15,800 results were found**

"School feeding" OR "school meals" OR "school food" AND "school children" OR "primary school children" OR "African" OR "School learners" **16,300 results were found**

"School gardens" OR "school gardening" OR "school farm" OR "demonstration farm" OR "demonstration garden" OR "field school" AND "school children" OR "primary school children" OR "African" OR "School learners" OR "Nutrition status" OR "stunting" OR "food quality" **425 results were found**

"School gardens" OR "nutrition education" OR "school feeding" OR "nutrition activities" OR "teacher led interventions" OR "school nutrition" AND "school children" OR "primary school children" OR "African" OR "School learners" OR "Nutrition status" OR "stunting" **373 results were found**

"School gardens" OR "nutrition education" OR "school feeding" OR "nutrition activities" OR "teacher led interventions" OR "school nutrition" AND "school children" OR "primary school children" OR "African" OR "School learners" OR "Nutritional status" OR "stunting" NOT "USA" OR "Europe" **16,900 results were found**

"Teacher role in nutrition" OR "school nutrition services" OR "teachers and nutrition" OR "primary school educators" AND "nutrition" OR "Nutrition status" OR "Child health" OR "Child weight" **556 results were found**

"Nutrition in primary schools" "Sub Saharan" "Nutrition education" **3 results were found**

"Nutrition in primary schools" "Sub Saharan" "School feeding" **1 result was found**

LILACS DATABASE

(tw:(teacher role in school nutrition)) OR (tw:(teacher- based nutrition interventions)) OR (tw:(school feeding)) OR (tw:(nutrition education)) OR (tw:(school gardens)) OR (tw:(nutrition in primary schools)) OR (tw:(role of teachers in school nutrition)) AND (tw:(africa)) OR (tw:(sub saharan africa)) AND (instance:"regional") AND (la:"en") **26 results found**

(tw:(nutrition roles of teachers in primary schools)) AND (tw:(Sub Saharan Africa)) **No documents were found for your search**

(tw:(school feeding)) OR (tw:(school lunch)) OR (tw:(meals at school)) OR (tw:(feeding at school)) AND (tw:(sub saharan africa)) OR (tw:(africa)) AND (instance:"regional") **1017 results found**

(tw:(teacher role in school nutrition)) OR (tw:(school based nutrition)) OR (tw:(nutrition education by teachers)) OR (tw:(teacher led nutrition interventions)) AND (tw:(Africa)) **No documents were found for your search**

(tw:(school nutrition services)) OR (tw:(nutrition education)) OR (tw:(school feeding)) AND (tw:(africa)) OR (tw:(sub saharan africa)) AND (instance:"regional") AND (instance:"regional") **2 results found**

(tw:(nutrition interventions in schools)) AND (tw:(africa)) AND (instance:"regional") **9 results found**

(tw:(nutrition education)) AND (tw:(primary schools)) AND (tw:(africa)) AND (instance:"regional") **20 results found**

Project MUSE

Search Results For: all of the terms [*school*] [*feeding*] [*in*] [*Africa*] in content, and all of the terms [*school*] [*gardens*] [*in*] [*Africa*] in content, and all of the terms [*school*] [*nutrition*] [*education*] in content, and all of the terms [*teacher*] [*led*] [*nutrition*] [*interventions*] [*in*] [*African*] [*schools*] in content, and all of the terms [*teacher*] [*nutrition*] [*education*] [*to*] [*pupils*] [*in*] [*Africa*] in content, and all of the terms [*school*] [*demonstration*] [*gardens*] [*in*] [*Africa*] in content, and all of the terms [*school*] [*lunch*] [*in*] [*African*] [*primary*] [*schools*] in content Content Type: Journal Doctype: Article Year(s): 2015-2000 (**0 results**)

Search Results For: all of the terms [*school*] [*feeding*] [*in*] [*africa*] in content, and all of the terms [*school*] [*gardens*] [*in*] [*africa*] in content, and all of the terms [*school*] [*nutrition*] [*education*] in content, and all of the terms [*teacher*] [*led*] [*nutrition*] [*interventions*] [*in*] [*african*] [*schools*] in content, and all of the terms [*teacher*] [*nutrition*] [*education*] [*to*] [*pupils*] [*in*] [*africa*] in content, and all of the terms [*school*] [*demonstration*] [*gardens*] [*in*] [*africa*] in content, and all of the terms [*school*] [*lunch*] [*in*] [*african*] [*primary*] [*schools*] in content Content Type: Journal Doctype: Article (**0 results**)

Search Results For: all of the terms [*school*] [*gardening*] [*in*] [*Africa*] [*primary*] [*schools*] in content Language: English Content Type: Journal Doctype: Article Year(s): 2015-2000 (**32 results**)

Search Results For: all of the terms [*school*] [*feeding*] [*in*] [*Africa*] [*primary*] [*schools*] in content Language: English Content Type: Journal Doctype: Article Year(s): 2015-2000 (**131 results**)

Search Results For: all of the terms [*school*] [*feeding*] [*in*] [*Africa*] [*primary*] [*schools*] in content Language: English Year(s): 2015-2000 (**132 results**)

Search Results For: all of the terms [*nutrition*] [*education*] [*in*] [*Africa*] [*primary*] [*schools*] in content Language: English Year(s): 2015-2000 (**124 results**)

Search Results For: all of the terms [*teacher*] [*nutrition*] [*education*] [*in*] [*Africa*] [*primary*] [*schools*] in content Language: English (**47 results**)

Search Results For: all of the terms [*primary*] [*school*] [*based*] [*nutrition*] [*interventions*] in content Language: English Content Type: Journal Doctype: Article (**12 results**)

Search Results For: all of the terms [*primary*] [*school*] [*based*] [*nutrition*] [*interventions*] in content Language: English Content Type: Journal Doctype: Article Free: Open (**14 results**)

Search Results For: all of the terms [*teacher*] [*nutrition*] [*interventions*] [*in*] [*africa*] in content, and all of the terms [*nutrition*] [*interventions*] [*by*] [*teachers*] [*in*] [*africa*] in content Language: English Content Type: Journal Doctype: Article (**2 results**)

EBISCO

#	Query	Limiters/Expanders	Last Run Via	Results
S14	(Teacher led nutrition in primary schools in Africa) AND (S8 AND S9 AND S10 AND S11 AND S12 AND S13)	Search modes - Boolean/Phrase	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	0
S13	Teacher led nutrition in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	81
S12	School feeding in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	2,079
S11	School gardens in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	1,909
S10	School gardens in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-	Interface – EBSCO host Research Databases Search Screen - Advanced	1,770

		20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Search Database – Green FILE; Library, Information Science & Technology Abstracts	
S9	Nutrition education in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	1,056
S8	Teacher nutrition education in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	93
S6	Teacher led nutrition in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database - GreenFILE;Library, Information Science & Technology Abstracts	81
S5	school feeding in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	2,079

S4	School gardens in primary schools in Africa	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	1,909
S3	School gardens in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	1,770
S2	Nutrition education in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	1,056
S1	Teacher nutrition education in primary schools	Limiters - Full Text; Scholarly (Peer Reviewed) Journals; Publication Date: 20000101-20151231 Expanders - Apply related words; Also search within the full text of the articles Search modes - SmartText Searching	Interface – EBSCO host Research Databases Search Screen - Advanced Search Database – Green FILE; Library, Information Science & Technology Abstracts	93

Note: The search was saved and can be retrieved. Saturday, July 02, 2016 4:55:18 AM

TRIP DATABASE- PICO SEARCH

(Primary school children)(Nutrition education)(Nutrition status) 1,582 results for “(primary school children) (nutrition education)(nutrition status)”, by quality

(Primary school children)(School feeding)(Nutrition status) 793 results for “(primary school children) (school feeding) (nutrition status)”, by quality

(Primary school children)(School gardening)(Nutrition status) 97 results for “(primary school children) (school gardening) (nutrition status)”, by quality

(Primary learners in Africa)(Nutrition education)(Nutrition status) 10 results for “(primary learners in Africa)(nutrition education)(nutrition status)”, by quality

10 results for “(title: primary learners in Africa OR Children OR Primary School Children)(title: nutrition education OR school gardens OR School feeding)(title: nutrition status OR food choices OR Anthropometry OR Wasting OR Stunting)”, by quality

The results were saved by starring on 2nd July 2016 and can be retrieved

EMERALD INSIGHT

“Nutrition interventions through teachers” OR “school nutrition interventions” OR “teacher led nutrition interventions” Articles/Chapters (1286) Case Studies (5)

“nutrition education” OR “school feeding programs” AND Africa Articles/Chapters (1645) Case Studies (11)

‘Nutrition interventions through teachers’ OR “school nutrition interventions” OR “teacher led nutrition interventions” Articles/Chapters (1286) Case Studies (5)

The search strategy was saved and can be retrieved. 2nd & 3rd July 2016

APPENDIX II: WORK PLAN

Activity	Details	Expected Completion Date
Proposal writing	Approval of study review by Faculty of Health Sciences	March 2016
	Write proposal	April 2016
	Approval of proposal	May 2016
Searching and identification of studies	Identify relevant studies from electronic databases and other electronic sources	June 2016
	Screening and Identification of eligible studies	June 2016
	list of included studies	June 2016
Data extraction	Adopt and adapt extraction tools	July 2016
	Complete data extraction	July 2016
Data analysis	Complete analysis	July 2016
Reporting and dissemination	Complete report	August 2016
	Submit report for marking	August 2016
	Oral defence of report	September 2016
	Submit final report	September 2016

APPENDIX III: BUDGET FOR THE STUDY

Activity	Unit(s)	Unit Cost (UGX)	Amount (UGX)
Proposal writing	1	N/A	0
Searching and identification of studies	1	N/A	N/A
Data extraction or collection	1	200,000	200,000
Data analysis	1	400,000	400,000
Reporting and dissemination	1	200,000	200,000
Total			800,000

APPENDIX IV: MAP AND LIST OF SUB SAHARA AFRICAN COUNTRIES

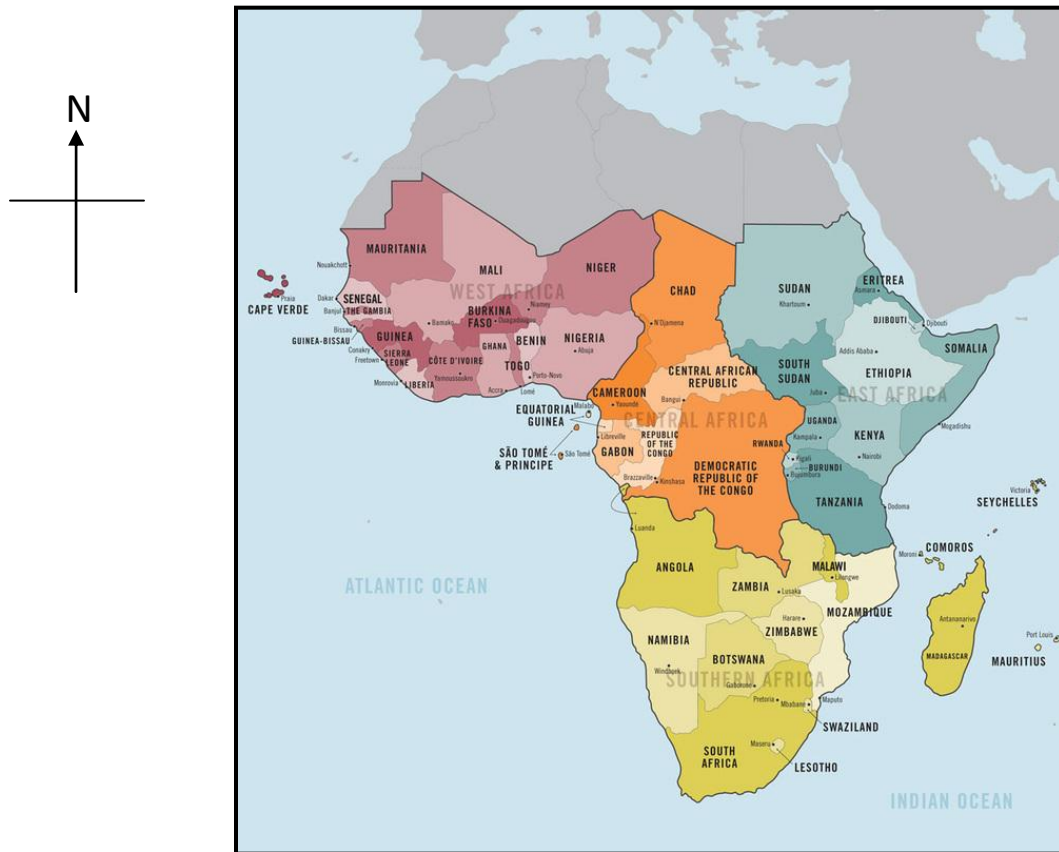


Figure 4 showing Map of Sub Saharan Africa

Source: Google Maps

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of the Congo, Cote D'Ivoire (Ivory Coast), Djibuti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, N. Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

**APPENDIX V: PREFERRED REPORTING ITEMS FOR SYSTEMATIC REVIEWS AND META-ANALYSIS
(2009) CHECKLIST**

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implication of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify the study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all intended information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search strategy	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Selection process	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, include in the meta-analysis).	
Data collection process	10	Describe method of data extraction data from reports (e.g., piloting forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICO items, funding sources), any data assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods for assessing risk of bias of individual studies (including specification of whether this was	

		done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining data of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	
Results of individual Studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

APPENDIX VI: DATA EXTRACTION FORM FOR INTERVENTION REVIEWS: RCTS ONLY VERSION 3,

APRIL 2014

Review title or ID	
Study ID (<i>surname of first author and year first full report of study was published e.g. Smith 2001</i>)	
Notes	

General Information

Date form completed (<i>dd/mm/yyyy</i>)	
Name/ID of person extracting data	
Reference citation	
Study author contact details	
Publication type (<i>e.g. full report, abstract, letter</i>)	
Notes:	

Study eligibility

Study Characteristics	Eligibility criteria <i>(Insert inclusion criteria for each characteristic as defined in the Protocol)</i>	Eligibility criteria met?			Location in text or source (<i>pg & ¶/fig/table/other</i>)
		Yes	No	Unclear	
Type of study	Randomised controlled trial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Quasi-randomised controlled trial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Participants		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Types of intervention		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Types of comparison		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Types of outcome measures		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
INCLUDE <input type="checkbox"/>		EXCLUDE <input type="checkbox"/>	
Reason for exclusion			
Notes:			

DO NOT PROCEED IF STUDY EXCLUDED FROM REVIEW

Characteristics of included studies

Methods

	Descriptions as stated in report/paper	Location in text or source (pg & ¶/fig/table/other)
Aim of study (e.g. efficacy, equivalence, pragmatic)		

Design (e.g. parallel, crossover, non-RCT)		
Unit of allocation (by individuals, cluster/ groups or body parts)		
Start date		
End date		
Duration of participation (from recruitment to last follow-up)		
Ethical approval needed/ obtained for study	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Yes No Unclear	
Notes:		

Participants

	Description	Location in text or source (pg & ¶/fig/table/other)
Population description (from which study participants are drawn)		
Setting (including location and social context)		
Inclusion criteria		
Exclusion criteria		
Method of recruitment of participants (e.g. phone, mail, clinic patients)		
Informed consent obtained	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear	
Total no. randomised (or total pop. at start of study for non-RCTs)		
Clusters (if applicable, no., type, no. people per cluster)		
Baseline imbalances		

Withdrawals and exclusions <i>(if not provided below by outcome)</i>		
Age		
Sex		
Race/ethnicity		
Other relevant socio demographics		
Subgroups measured		
Subgroups reported		
Notes:		

Intervention groups

Copy and paste table for each intervention and comparison group

Intervention Group 1

	Description as stated in report/paper	Location in text or source <i>(pg & ¶/fig/table/other)</i>
Group name		

No. randomised to group (<i>specify whether no. people or clusters</i>)		
Theoretical basis (<i>include key references</i>)		
Description (<i>include sufficient detail for replication, e.g. content, dose, components</i>)		
Duration of treatment period		
Timing (<i>e.g. frequency, duration of each episode</i>)		
Delivery (<i>e.g. mechanism, medium, intensity, fidelity</i>)		
Providers (<i>e.g. no., profession, training, ethnicity etc. if relevant</i>)		
Co-interventions		
Economic information (<i>i.e. intervention cost, changes in other costs as result of intervention</i>)		
Resource requirements (<i>e.g. staff numbers, cold chain, equipment</i>)		
Integrity of delivery		
Compliance		

Notes:

Outcomes

Copy and paste table for each outcome.

Outcome 1

	Description as stated in report/paper	Location in text or source (pg & ¶/fig/table/other)
Outcome name		
Time points measured (specify whether from start or end of intervention)		
Time points reported		
Outcome definition (with diagnostic criteria if relevant)		
Person measuring/ reporting		
Unit of measurement (if relevant)		
Scales: upper and lower limits (indicate whether high or low score is good)		
Is outcome/tool validated?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear	

Imputation of missing data (<i>e.g. assumptions made for ITT analysis</i>)		
Assumed risk estimate (<i>e.g. baseline or population risk noted in Background</i>)		
Power (<i>e.g. power & sample size calculation, level of power achieved</i>)		
Notes:		

Other

Study funding sources (<i>including role of funders</i>)		
Possible conflicts of interest (<i>for study authors</i>)		
Notes:		

Risk of Bias assessment

Domain	Risk of bias Low High Unclear	Support for judgement <i>(include direct quotes where available with explanatory comments)</i>	Location in text or source <i>(pg & ¶/fig/table/other)</i>
Random sequence generation <i>(selection bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
Allocation concealment <i>(selection bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
Blinding of participants and personnel <i>(performance bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group: All/	
<i>(if separate judgement by outcome(s) required)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group:	
Blinding of outcome assessment <i>(detection bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group: All/	
<i>(if separate judgement by outcome(s) required)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group:	
Incomplete outcome data <i>(attrition bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group: All/	

<i>(if separate judgement by outcome(s) required)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Outcome group:	
Selective outcome reporting? <i>(reporting bias)</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
Other bias	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
Notes:			

Data and analysis

Copy and paste the appropriate table for each outcome, including additional tables for each time point and subgroup as required.

Dichotomous outcome

	Description as stated in report/paper				Location in text or source (pg & ¶/fig/table/other)
Comparison					
Outcome					
Subgroup					
Time point (specify from start or end of intervention)					
Results	Intervention		Comparison		
	No. with event	Total in group	No. with event	Total in group	
Any other results reported (e.g. odds ratio, risk difference, CI or P value)					
No. missing participants					
Reasons missing					

No. participants moved from other group			
Reasons moved			
Unit of analysis (<i>by individuals, cluster/groups or body parts</i>)			
Statistical methods used and appropriateness of these (<i>e.g. adjustment for correlation</i>)			
Reanalysis required? (<i>specify, e.g. correlation adjustment</i>)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear		
Reanalysis possible?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear		
Reanalysed results			
Notes:			

Continuous outcome

	Description as stated in report/paper	Location in text or source (<i>pg & ¶/fig/table/other</i>)
Comparison		
Outcome		

Subgroup							
Time point (<i>specify from start or end of intervention</i>)							
Post-intervention or change from baseline?							
Results	Intervention			Comparison			
	Mean	SD (<i>or other variance, specify</i>)	No. participants	Mean	SD (<i>or other variance, specify</i>)	No. participants	
Any other results reported (<i>e.g. mean difference, CI, P value</i>)							
No. missing participants							
Reasons missing							
No. participants moved from other group							
Reasons moved							
Unit of analysis (<i>individuals, cluster/groups or body parts</i>)							

Statistical methods used and appropriateness of these (<i>e.g. adjustment for correlation</i>)		
Reanalysis required? (<i>specify</i>)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear	
Reanalysis possible?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unclear	
Reanalysed results		
Notes:		

Other outcome

	Description as stated in report/paper	Location in text or source (<i>pg & ¶/fig/table/other</i>)
Comparison		
Outcome		
Subgroup		
Time point (<i>specify from start or end of intervention</i>)		
No. participant	Intervention	Control

Results	Intervention result	SE (or other variance)	Control result	SE (or other variance)
	Overall results		SE (or other variance)	
Any other results reported				
No. missing participants				
Reasons missing				
No. participants moved from other group				
Reasons moved				
Unit of analysis (<i>by individuals, cluster/groups or body parts</i>)				
Statistical methods used and appropriateness of these				
Reanalysis required? (<i>specify</i>)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Yes	No	Unclear	

Reanalysis possible?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Yes No Unclear		
Reanalysed results			
Notes:			

Other information

	Description as stated in report/paper	Location in text or source (<i>pg & ¶/fig/table/other</i>)
Key conclusions of study authors		
References to other relevant studies		
Correspondence required for further study information (<i>from whom, what and when</i>)		
Notes:		

APPENDIX VII: THE COCHRANE COLLABORATION'S TOOL FOR ASSESSING RISK OF BIAS

Domain	Support for Judgment
<i>Selection bias.</i>	
Random sequence generation.	Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.
Allocation concealment.	Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during, enrolment.
<i>Performance bias.</i>	
Blinding of participants and personnel <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.
<i>Detection bias.</i>	
Blinding of outcome assessment <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe all measures used, if any, to blind outcome assessors from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.
<i>Attrition bias.</i>	
Incomplete outcome data <i>Assessments should be made for each main outcome (or class of outcomes).</i>	Describe the completeness of outcome data for each main outcome, including attrition and exclusions from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compared with total randomized participants), reasons for attrition/exclusions where reported, and any re-inclusions in analyses performed by the review authors.
<i>Reporting bias.</i>	
Selective reporting.	State how the possibility of selective outcome reporting was examined by the review authors, and what was found.

APPENDIX VIII: THE JADAD SCALE

1. Was the study described as randomized (this includes words such as randomly, random, and randomisation)? (+1 Point)
2. Was the method used to generate the sequence of randomisation described and appropriate (table of random numbers, computer-generated, etc)? (+1 Point)
3. Was the study described as double blind? (+1 Point)
4. Was the method of double blinding described and appropriate (identical placebo, active placebo, dummy, etc)? (+1 Point)
5. Was there a description of withdrawals and dropouts? (+1 Point)
6. Deduct one point if the method used to generate the sequence of randomisation was described and it was inappropriate (patients were allocated alternately, or according to date of birth, hospital number, etc)
7. Deduct one point if the study was described as double blind but the method of blinding was inappropriate (e.g., comparison of tablet vs. injection with no double dummy).

APPENDIX IX: CRITICAL APPRAISAL CHECKLIST

ITEM	YES (Y)	NO (N)	NOT CLEAR (U)	N/A
<p>Section A: population</p> <p>Is the study population representative of all users, actual and eligible, who might be included in the study?</p> <p>Are inclusion and exclusion criteria definitively outlined?</p> <p>Is the sample size large enough for sufficiently precise estimates?</p> <p>Is the choice of population bias-free?</p> <p>If a comparative study:</p> <p>Were participants randomized into groups?</p> <p>Were the groups comparable at baseline?</p> <p>If groups were not comparable at baseline, was incomparability addressed by the authors in the analysis?</p> <p>Was informed consent obtained?</p>				
<p>Section B: data collection</p> <p>Are data collection methods clearly described?</p> <p>Is the data collection instrument validated?</p> <p>If based on regularly collected statistics, are the statistics free from subjectivity?</p> <p>Does the study measure the outcome at a time appropriate for capturing the intervention's effect?</p> <p>Is the instrument included in the publication?</p> <p>Are questions posed clearly enough to be able to elicit precise answers?</p>				
<p>Section C: study design</p> <p>Is the study type/methodology utilized appropriate/Is there face validity?</p> <p>Is the research methodology clearly stated at a level of detail that would allow its replication?</p> <p>Was ethics approval obtained?</p> <p>Are the outcomes clearly stated and discussed in relation to the data collection?</p>				
<p>Section D: results</p> <p>Are all the results clearly outlined?</p> <p>Are confounding variables accounted for?</p> <p>Do the conclusions accurately reflect the analysis?</p> <p>Is subset analysis a minor, rather than a major, focus of the article?</p> <p>Are suggestions provided for further areas to research?</p> <p>Is there external validity?</p>				

The calculation for overall validity:

YES- gives a positive mark while N & U- give a negative mark. N/A does not add up in the formula
 If $Y = T$ or if $Y + N + U = T$, if $Y/T \geq 75$ percent then you can safely conclude that the study is valid.

APPENDIX X: STRENGTH OF A BODY OF EVIDENCE ASSESSMENT TOOL

Evidence of effectiveness	Execution-Fair or Good	Design Suitability Greatest, moderate or least	Number of studies	Consistent	Effect Size	Expert Opinion
Strong	Good	Greatest	At least 2	Yes	Sufficient	Not used
	Good	Greatest or moderate	At least 5	Yes	Sufficient	Not used
	Good or Fair	Greatest	At least 5	Yes	Sufficient	Not used
	Meet design, execution, number and consistency criteria for sufficient but not strong evidence				Large	Not used
Sufficient	Good	Greatest	1	Not applicable	Sufficient	Not used
	Good or Fair	Greatest or Moderate	At least 3	Yes	Sufficient	Not used
	Good or Fair	Greatest, Moderate or Least	At least 5	Yes	Sufficient	Not used
Expert opinion	Varies	Varies	Various	Varies	Sufficient	Supports a recommendation
Insufficient	Insufficient designs or execution		Too few studies	Inconsistent	Small	Not used

APPENDIX X: REFERENCES TO ALL ELIGIBLE STUDIES

Adelman, S., Alderman, H., Gilligan, D.O., Lehrer, K., 2008. The impact of alternative food for education programs on learning achievement and cognitive development in Northern Uganda. Unpublished manuscript.

Alderman, H., Gilligan, D.O., Lehrer, K., 2013. The impact of food for education programs on school participation in northern Uganda.

Ash, D.M., Tatala, S.R., Frongillo, E.A., Ndossi, G.D., Latham, M.C., 2003. Randomized efficacy trial of a micronutrient-fortified beverage in primary school children in Tanzania. The American journal of clinical nutrition 77, 891–898.

Auld, G.W., Romaniello, C., Heimendinger, J., Hambidge, C., Hambidge, M., 1998. Outcomes from a school-based nutrition education program using resource teachers and cross-disciplinary models. Journal of Nutrition Education 30, 268–280.

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APPENDIX XI: STUDIES REVIEWED

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