博士論文

Improving feeding practices and nutrition status of HIV-positive children in Tanga,

Tanzania: the roles of health workers' nutrition training

（タンザニアのタンガにおける HIV 陽性児の摂食行動と栄養状態改善：

ヘルスワーカー・栄養トレーニングの役割）

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
AOR	Adjusted Odd Ratio
ART	Antiretroviral Therapy
BMI	Body Mass Index
CD_4	Cluster of Differentiation 4
CDR	Center for Review and Dissemination
CDSR	Cochrane Database of Systematic Reviews
CI	Confidence Interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CME	Continuous Medical Education
COREQ	Consolidated Criteria for Reporting Qualitative research
CPD	Continuing Professional Development
CTC	Care and Treatment Center
DARE	Database of Abstracts of Reviews of Effects
DDS	Dietary Diversity Scale
EMBASE	Excerpta Medica Database
ERIC	Educational Resources and Information Center
FGD	Focus Group Discussions
GP	General Practitioners
GRADE	Grades of Recommendation, Assessment, Development, and Evaluation
HAZ	Height-for-Age Z-score
HFIAS	Household Food Insecurity Access Scale
HIV	Human Immunodeficiency Virus
ILO	International Labor Organization
IMCI	Integrated Management of Childhood Illnesses
ITT	Intention To Treat
IYCF	Infants and Young Child Feeding

LHV	Lady Health Visitors
MLP	Midlevel Provider
MUST	Malnutrition Universal Screening Tool
NICE	National Institute for Health and Clinical Excellence
NNRTI	Non Nucleoside Reverse Transcriptase Inhibitor
NRTI	Nucleoside Reverse Transcriptase Inhibitors
OIs	Opportunistic Infections
OR	Odd Ratio
PCA	Principal Component Analysis
PICO	Population, Intervention, Comparator, Outcome
PIr	Protease Inhibitor boosted
PLHIV	People Living with HIV
PMTCT	*Prevention of Mother to Child Transmission*
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized Controlled Trial
RoB	Risk of Bias
SD	Standard Deviation
SMD	Standardized Mean Difference
TDHS	Tanzania Demographic and Health Survey
UK	United Kingdom
UNICEF	United Nations Children's Fund
UNICEF	United Nations Children's Fund
USA	United States of America
VIF	Variance Inflating Factor
WAZ	Weight-for-Age Z-score
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

Abstract

Background

This thesis covered four objectives. To examine the effectiveness of nutrition training of heath workers on their nutrition knowledge, skills, and competence to manage child undernutrition; and on children's feeding practices. It also aimed to examine magnitudes of undernutrition among HIV-positive children in Tanga, Tanzania; and the efficacy of nutrition training intervention of midlevel providers (MLPs) on their nutrition knowledge, feeding practices, anthropometry, and nutrition status of HIV-positive children.

Methods

Evidence was retrieved from medical databases for the two systematic reviews. Data was collected from 748 pairs of HIV-positive children and their caregivers attending 9 out of 32 care and treatment centers (CTCs) and seven focus group discussions for the formative research. The cluster RCT was conducted in 16 CTCs, and eight of them randomized into intervention arm. A total of 776 HIV-positive children were recruited at baseline and followed for six months.

Results

Nutrition training improved health workers' nutrition knowledge, skills, competence to manage child undernutrition, and children's feeding practices. About 62% and 39% of HIV-positive children had stunting and underweight respectively in Tanga, Tanzania. Feeding frequency was low and associated with stunting (β=0.11, p=0.016), underweight (β=0.12, p=0.029), and thinness (β=0.11, p=0.026). Nutrition training of MLPs improved their nutrition knowledge post-training (37.1 vs. 23.5, p<0.001). It further improved feeding frequency (β=1.17, p<0.001), which was associated with improved weight (β=1.27, p<0.001), and BMI (β=1.19, p<0.001), but not height (β= -0.10, p = 0.830).

Conclusion

Nutrition training can improve health workers' nutrition knowledge. It can also improve feeding practices, and ultimately nutrition status of HIV-positive children.

Key words: Nutrition sciences, health personnel, feeding behavior, nutrition status, HIV, children

Chapter 1: Background

1.1 General introduction

1.1.1 HIV epidemic and challenges among infected children

HIV epidemic has reached a plateau or declining in the affected regions after more than thirty years of devastation (1). The absolute number of people living with HIV (PLHIV) is increasing, however, new infections rate has declined by 33% between 2001 and 2012 (1). This success was brought about by a combination of interventions such as behavior interventions, health promotion, and life saving medications – the antiretroviral therapy ART. In particular, the coverage of ART had increased to cover 9.7 million eligible PLHIV by 2012. This prevented 6.6 milion deaths that would have resulted from HIV (1).

ART has also reduced new pediatric HIV infections through prevention of mother to child transmission (PMTCT) intervention. The 57% PMTCT coverage rate has brought down HIV transmission rate by 35% by the year 2012 (1). However, about 700 new pediatric HIV infections occur everyday globally even after such gains. This has resulted in about 3.3 million children aged 0-14 years who live with HIV globally (2). Among them, more than 90% resides in Sub-Sahara Africa.

HIV-positive children succumb to multiple adverse outcomes. HIV-positive children are at an increased risk of such adverse outcomes compared to their HIV-negative counterparts owing to their socio-demographic disadvantages (3-5). The disease affects households where HIV-positive children resides causing unsustainable income, inability to work, and resulting into economic hardships (6). This lowers their purchasing power. As a result households are unable to buy adequate and quality foods even when they are available in the markerts (7). Such households therefore suffer from persistent food insecurity and hunger, which are important determinant of child undernutrition (8-10).

A path towards undernutrition may also start while HIV-positive children are still unborn (11). The HIV may affect fetal immune functions if it crosses the placental barrier. In this way the virus may cause abnormalities in their cell-mediated immunity and T-lymphocyte maturation in such early life

(11). It may lead to a range of perinatal problems including low birth weight (11), also an important determinant of child growth and survival. Morerover, the use of ART for PMTCT is associated with low length for age and head circumference at one year (12, 13).

1.1.2 Risks and consequences of child undernutrition

HIV infection has a risk to child undernutrition. It impairs body's immunity and thus leaving the patient vulnerable to opportunistic infections that increase the risk to undernutrition (14, 15). The two are immune-compromizing conditions (16). Children suffering from both conditions have high risk of frequent and severe opportunistic infections (16), derailed growth (17), poor cognitive development (18-21), and early deaths (17) than their counterparts. Such risks are present even HIV-positive children are treated with ART (17, 22).

Undernutrition and derailed growth can take acute severe or chronic form among HIV-positive children. Acute undernutrition results from acute opportunistic infections such as diarrhea and acute respiratory infections; acute shortage of food and hunger; and HIV constitutional symptoms including nausea, vomiting, lack of apetite, and febrile illnesses (3). HIV-positive children may also succumb to stunting, a chronic form of undernutrition when acute undernutrition is prolonged (23). Stunting may also result from chronic opportunistic infections such as Tuberculosis; HIV-related malignancy conditions such as Kaposis Sarcoma; and persistent food insecurity or hunger (22).

Undernutrition is an underlying cause of more than one third of child mortality globally (24). Mortality risk is higher among undernourished HIV-positive children compared to their HIV-negative counterparts (25). HIV-positive children still suffer from high mortality rates if they are undernourished (25, 26) even if they are treated with ART (27). Undernutrition may directly cause such deaths through lack of essential energy and nutrients to afford the body's metabolism. It may also cause weakening child's immunity to fight diseases (15, 28). As a result, they are more susceptible to and frequent more opportunistic infections (14, 29) and death (15, 28).

Initiation of ART may help to reduce disease burden by improving immunity. This helps to replenish weight loss due to the opportunistic infections (30, 31). However, HIV-positive children may still suffer from both acute and chronic undernutrition even if they are treated with ART (22). Moreover, side effects posed by ART tend to increase among undernourished and underfed children (7, 32, 33). ART initiation among them may lead to symptoms similar to micronutrient deficiency such as anaemia (34). Such effects of undernutrition may further subject HIV-positive children to advanced stages of the HIV-related diseases (7). In this context, ART alone is not enough unless other interventions address undernutrition are applied (22).

Undernutrition among HIV-positive children may also predispose them to poor mental development in addition to poor physical growth. The first 1000 days (between conception to the second birthday) are important in brain, psychosocial, and cognitive development. Lack of appropriate nutrition at this stage may lead to a permanent effect resulted from slower brain growth, delayed motor and cognitive functions, impaired psychosocial development, and behavioural challenges (35-38). ART can potentially prolong longevity of children born and living with HIV. However, compared to HIV-negative children, HIV-positive children are more likely to enter a cycle of poverty and suffering in their adulthood if they had childhood undernutrition compared to their HIV-negative counterparts.

Child undernutrition is also a risk factor to non-communicable diseases including hypertension, dyslipidemia, stroke, and early deaths (39, 40). In this aspect, undernuritiont is thus regarded to as a result and a cause of the poverty (**Figure 1**). By preventing and treating child undernutrition while maintaining them on ART, the intergenerational vicious cycle of poverty can be halted among PLHIV.

Figure 1: Conceptual framework of determinants and consequences of child undernutrition

Short-term consequences: Morbidity, mortality, and disability

Long-term consequences: cognitive ability, economic productivity, reproduction, NCDs

Intergenerational consequences

Child undernutrition

Immediate causes

Inadequate dietary intake

Diseases

Underlying causes

Household food security

Inadequate care and feeding practices

Unhealthy household environment, inadequate healthcare

Household access to adequate quantity and quality of resources: land, education, employment, income, and technology

Basic causes

Inadequate financial, human physical and social capital

Sociocultural, economic, and political environment

Adapted and modified from the UNICEF reports 1990, 2013

1.1.3 Special nutritional consideration for HIV-positive children

HIV-positive children have different nutritional needs at various stages of their disease (41). Adequate and appropriate foods can help them maintain their immunity and other body functions. Additional nutrients and energy are required when they present with diseases or symptoms (42). For example, HIV-positive children suffering from mild symptoms need additional 10% of energy that would sustain an otherwise HIV-negative child (41, 42).

HIV-positive children need an additional 20-30% of energy and proteins amounted to 10-15% of the total energy needed if they suffer from acute infections, malignancy, tuberculosis, and other chronic lung diseases (41, 42). This can help to replenish energy and nutritional loss due to inflammatory and recovery processes. They need extra 50-100% of the normal requirement of energy to replenish the lost weight and help recover when they have Aquired Immunodefficiency Syndomme (AIDS) (41, 42). Special interventions are essential and should be tailored to suit disease stages of HIV-positive children.

1.1.4 Interventions to combat undernutrition among HIV-positive children

Undernutrition among HIV-positive children results from multifaceted causes. The disease it self is a risk factor of acute (wasting and underweight) and chronic undernutrition (stunting). Treating HIV-positive children using ART may minimize risk of undernutrition (31). However, ART alone is not enough due to socio-demographic disadvantages resulting from the disease (22). These include poverty, food insecurity, low-level of caregivers' education, poor feeding practices, and loss of parents (8, 22, 43).

Interventions are available to mitigate the determinants of child undernutrition (44, 45). They include infants and young child feeding interventions (IYCF) (46); food assistance to households in food insecurity (7, 47); food preparation hygiene and prevention or treatment of diarrhea (48); interventions focusing on households in poverty; and improving caregivers' low levels of education (22). A combination of intervention is necessary. This is because, a number of determinants may affect one HIV-positive child and cause undernutrition (24). Therefore, the one-size fits all approach may not

help to contain child undernutrition. For example, some regions may have high food production but high child undernutrition (49). In such settings, poor knowledge among caregivers may determine such magnitude of child undernutrition. It may result from lack of adequate knowledge of caregivers to feed their children, to prepare foods based on age and need, to give adequate of locally available foods, or to store the excess. Nutrition training and counseling are essential to solve the problem of undernutrition in such contexts.

1.1.5 Human resource for health crisis: a bottleneck of nutrition interventions

Undernutrition can be ameliorated if caregivers receive the right information on feeding practices (50). This cannot be realized when qualified health workers are scarce (51). Globally, medical and nursing trainings have not emphasized the nutrition education. As a result, the graduates have poor nutrition knowledge (52). Such flaw can be corrected if inservice nutrition training is providing to those disadvantaged health workers (53).

Nutrition training can improve knowledge, nutrition counseling skills, and competence of health workers to manage children with poor nutrition status using locally available resources (54). This in turn can help to improve feeding practices through tailor-made nutrition counseling and frequent follow-ups (50, 55). Improved feeding practices can ultimately help to reduce the burden of undernutrition in general population (56).

1.1.6 Research gaps

A body of evidence is available on effectiveness of nutrition training of health workers to improve feeding practices and nutrition status among children in general population (55-58). However, evidence is not available in the context of HIV-positive children despite their higher risk of undernutrition compared to HIV-negative children (22). Moreover, inservice nutrition trainings have been designed and conducted for qualified medical personnels. A few studies have examined such trainings among community health workers and other lay personnels (59-61). None of such trainings were designed for and conducted among among midlevel providers (MLPs), a health cadre that is more popular among countries with human resources for health crisis (62). Tanzania is no exception.

MLPs in Tanzania are the main health workers in rural and sub-urban areas because of scarcity of other qualified medical doctors and registered nurses. They manage high burden of patients with minimal skills, expertise, and no continuing professional education. Such health workers are trained to manage simple medical and surgical conditions using straight forward guidelines (62). They may not include HIV-related diseases complicated with severe undernutrition.

Evidence is also lacking on effectiveness of nutrition training intervention in the food rich context. The traditional modality of managing undernutrition had emphasized food rationing, supplementary feeding with high calories ready to use therapeutic foods, and poverty alleviation using conditional cash transfers (63, 64). Such interventions may not work in the context where food is available but also have high magnitudes of undernutrition as a result of poor feeding practices or other factors.

1.1.7 Objectives of the thesis

This thesis had four objectives to address the mentioned research gaps. Each of them is explained in its own chapter:

1. To examine the effectiveness of inservice nutrition training interventions on health workers nutrition knowledge, counseling skills, and management of child undernutrition (Chapter 2)
2. To examine the effectiveness of health workers' inservice nutrition training interventions on feeding practices including feeding frequency, energy intake, and dietary diversity among children aged six months to two years (Chapter 3)
3. To examine the magnitudes of undernutrition and poor feeding practices among children attending care and treatment centers (CTCs) in a food rich region in Tanga, Tanzania (Chapter 4)
   - To examine the local determinants of undernutrition including its associations with poor feeding practices among HIV-positive children attending CTCs in Tanga, Tanzania
   - To examine the local factors associated with poor feeding practices, in particular, low feeding frequency among HIV-positive children attending CTCs in Tanga, Tanzania

4. To examine the efficacy of the nutrition training intervention to improve nutrition knowledge of MLPs who care for HIV-positive children, and to examine the efficacy of such nutrition training intervention on feeding practices and nutrition statuses of HIV-positive children attending CTCs in Tanga, Tanzania (Chapter 5 and 6)

1.1.8 Hypothesis and conceptual framework of the intervention study

It was hypothesized that, MLPs would have higher levels of nutrition knowledge after the nutrition training (54). Improved nutrition knowledge and skills to manage undernutrition among MLPs' will boost their ability to counsel caregivers using locally available foods. Feeding practices will improve as a result of nutrition counseling and routine follow-up (50). This will have an impact on weight gain and linear growth in a long-term (56). **Figure 1** shows the areas in the UNICEF's conceptual framework of determinants of undernutrition where the nutrition training of health workers may work to improve undernutrition among HIV-positive children and other children of the general population.

1.2 Organization of the thesis

1.2.1 Chapters included in this thesis

This thesis is organized into six chapters. The first chapter is made of the general introduction, summarizes objectives, and states the research gaps, objectives, and conceptual framework of the thesis. The next four chapters are composed of research conducted to address the four objectives--one for each chapter (Table 1). The last chapter is designated for general discussion and conclusion. It also states recommendations drawn from findings of this thesis and future perspectives in research on this topic.

For the research related sections, chapter two is made of a systematic review. It summarizes evidence of the effectiveness of nutrition training nutrition knowledge, practices, and competence of health workers to manage child undernutrition (54). In this systematic review, evidence was drawn from 25 out of 3910 research articles that fulfilled the inclusion criteria. Narrative synthesis was conducted to summarize the effectiveness of nutrition training interventions on the outcomes variables of interest.

Chapter three is also made of a systematic review. It examined the effectiveness of nutrition training of health workers on feeding practices for young children aged six months and two years (50). The feeding practices included feeding frequency, energy intake, and dietary diversity of children aged six months to two years. Ten out of 4757 articles retrieved from medical databases were eligible for the analysis in this review. Meta analyses and narrative synthesis were conducted to examine effectiveness of the intervention.

The chapters that followed utilized results drawn from the two systematic reviews in chapter two and three. They guide the researcher into the next phases of primary research among HIV-positive children in Tanzania. The primary research included a formative research and the interventional research designed as a randomized controlled trial.

The fourth chapter was made of the formative research conducted to examine nutrition situation among HIV-positive children. It was conducted in the selected care and treatment centers of a food rich region

of Tanga, Tanzania (49). It used a sequential mixed method design by conducting a cross-sectional quantitative first and then conducting a qualitative study to explain pertinent quantitative findings. It examined feeding practices and nutrition statuses of HIV-positive children using a quantitative cross sectional study. It was followed by seven focus group discussions (FGDs) to study the factors associated with undernutrition and poor feeding practices found in the cross sectional study. Results of both methods were triangulated to prepare for the tailored nutrition intervention.

Chapter five reports the cluster RCT. This was conducted among HIV-positive children attending CTCs in Tanga, Tanzania, following the protocol (65). The intervention in this cluster RCT followed the standard World Health Organization's (WHO) guideline, *Guidelines for an intergrated approach to the nutritional care of HIV-infected children aged 6 months to 14 years*. It aimed to improve poor feeding practices and nutrition status among HIV-positive children found in formative research (49).

The intervention of interest included nutrition training of midlevel providers (MLPs) who care for HIV-positive children in Tanzania. It was hypothesized that; nutrition training intervention would improve nutrition knowledge and competence to manage undernutrition among HIV-positive children. Improved knowledge would enable MLPs to provide tailor-made nutrition counseling to caregivers of HIV-positive children. Also it could improve their competence to manage child undernutrition. As a result, HIV-positive children would have better feeding practices and nutrition status.

Chapter six is made of the summary of findings, general discussions of findings, conclusions, and recommendations drawn from the four studies. It also explains the policy implications and remaining research challenges to be addressed in the future.

Table 1: Thesis at glance - core contents

This thesis is organized around five research articles

Study 1	Systematic review I
Aim	To examine the effectiveness of in-service nutrition training on health workers' nutrition knowledge, counseling skills, and undernutrition management practices
Methods	A systematic review on nutrition interventions on nutrition trainings for health workers. A narrative synthesis was conducted to summarize evidence of 25 out of 3910 retrieved articles that fulfilled inclusion criteria.
Results	Eighteen studies reported nutrition knowledge improvement among health workers' following the intervention. A total of 12 studies reported improved counseling skills and 16 showed improved management skills of child undernutrition.
Conclusion	In-service nutrition training improves quality of health workers by boosting their knowledge, competence and skills to manage child undernutrition.
Study 2	**Systematic review II**
Aim	To examine effectiveness of nutrition training of health workers on feeding practices of children aged six-months to two years.
Methods	A systematic review was conducted on randomized controlled trials (RCTs) with nutrition training interventions. Evidence was graded and meta analyses were conducted to examine effectiveness of intervention on feeding practices on ten RCTs.
Results	The intervention improved feeding frequency (SMD 0.48, 95% CI 0.38-0.58). It also improved energy intake and dietary diversity scores.
Conclusion	Nutrition training of health workers improves feeding frequency, dietary diversity and energy intake among children aged six-months to two years.
Study 3	**A formative research**
Aim	To examine magnitude of undernutrition and its association with poor feeding practices among HIV-positive children in Tanga, Tanzania
Methods	A sequential mixed-method design comprised of a cross sectional quantitative and qualitative studies. Data was collected from 748 pairs of children and their caregivers. Seven focus group discussions (FGDs) were conducted, each had eight participants.

Results	About 62% of HIV-positive children were stunted and 38% had underweight. About 88% were fed at a lower than recommended frequency and 62% at a low diversity of foods. Lower feeding frequency was associated with stunting, underweight, and thinness. Poor feeding frequency was associated with poverty, food insecurity, and low caregivers' education.
Conclusion	Feeding practices and nutrition statuses were poor among HIV-positive children even in food rich areas.
Study 4	**Intervention study**
Aim	To examine efficacy of nutrition training of midlevel providers on feeding practices anthropometry, and nutrition status of HIV-positive children in Tanga, Tanzania
Methods	A cluster RCT was conducted in 16 CTCs among 776 pairs of HIV-positive children and their caregivers. MLPs in 8 CTCs received in-service nutrition training intervention and gave nutrition counseling and management in intervention arm.
Results	The intervention improved feeding frequency and dietary diversity. In turn a modest weight gain of about 300g was observed in the intervention arm.
Conclusion	Nutrition training improved nutrition knowledge of MLPs. As a result feeding practices and a modest weight gain improved among HIV-positive children.

Chapter 2:

Nutrition training improves health workers' nutrition knowledge and competence to manage child undernutrition: a systematic review

2.1 Background

Child undernutrition can be reduced if health workers with adequate nutrition knowledge provide correct, adequate, and frequent nutrition advise to caregivers (56, 66). Across the globe, the quality of health workers' nutrition knowledge – and, by extension, their counseling skills – has been a concern (51, 67-70). Historically, medical training has lacked adequate and updated nutrition training that is in keeping with the situation and needs on the ground (52, 71, 72). As a result, health workers produced from teaching institutions have lacked adequate nutrition knowledge (51, 69). Such health workers may also lack the competence and skills to provide basic nutrition advice to their clients (66, 73). This incompetence, in turn, may be a factor deterring health workers from providing nutrition advice and management to their clients (74).

In-service nutrition training can help to improve health workers' nutrition knowledge (53, 75-77). This may facilitate positive changes in their attitudes towards nutrition care (78, 79) and thus in their behavior (80-82). As a result, health workers' skills in management of nutrition-related problems such as child undernutrition, including nutrition counseling skills (53, 59, 75, 76, 80, 83), may improve (84-86).

In practical terms, the process by which the knowledge acquired through nutrition training is translated into management practices may not be linear. However, the outcome of nutrition training can be explained using the conceptual framework of general behavioral theories. Based on the Health Belief Model (87), for example, knowledge or education on a perceived threat or disease is likely to influence behavior change. Untrained health workers may feel incompetent to provide counseling to their clients even when they know or perceive the threat caused by a nutrition problem. When such health workers are trained to recognize threats posed by nutrition-related problems, they are likely to provide appropriate care. In an ideal situation, knowledge can impact practical skills; it can thus change health workers' behaviors.

Changes in health workers' nutrition counseling behavior can be sustained even after the training ends. This may be due to the rewards they may receive in the positive results of improving child feeding practices and nutrition status. According to Bandura's social learning theory, a change can be influenced by being rewarded or punished as a result of one's actions (87). Health workers' counseling behavior may most likely last or recur if the nutrition knowledge received is used to counsel or manage a child with undernutrition so as to yield obvious improvements in the child's nutritional status.

Evidence is available for the impact of in-service nutrition training on health workers' nutrition knowledge, nutrition counseling skills, and management of child undernutrition. However, no systematic review has summarized such evidence towards effecting policy change. One review article demonstrated the importance of nutrition training for health workers (70). Other reviews have shown the effect of health workers' counseling of caregivers on feeding practices including dietary diversity, feeding frequency, and energy intake (50), complementary feeding, and children's nutritional status (56-58). However, I could not find any systematic review on the impact of nutrition training for health workers on their own knowledge, attitudes, and child undernutrition management practices. Therefore the objective of this systematic review was to evaluate the impact of nutrition training interventions among health workers on their own nutrition knowledge, nutrition counseling, and child undernutrition management practices.

2.2 Methods

2.2.1 PICO questions

The population, intervention, comparator, outcome (PICO) question to be addressed in this study was framed as follows: What is the effectiveness of nutrition training of health workers on their nutrition knowledge, nutrition counseling, and undernutrition management practices among children at risk of or suffering from undernutrition as compared to those who did not receive such training? For this review, I included studies with nutrition training interventions.

Nutrition training for health workers was defined as any form of in-service training given to health workers and designed for continuing professional development (CPD), continuous medical education (CME), nutrition trainings for research purposes, or as part of a health project or program. I used a World Health Organization (WHO) and International Labor Organization (ILO) definitions of health worker to select health cadres as the population of interest (88, 89). Such health cadres included doctors, nurses, midwives, mid-level providers, dieticians, nutritionists, and pharmacists.

Three outcome variables were assessed in this review: health worker's nutrition knowledge, nutrition counseling and/or general counseling skills, and management skills for child undernutrition. Health worker's nutrition knowledge was measured using a standard scale or pre-made set of questions to test knowledge specific to the training given. I regarded nutrition counseling as any specific advice given by a health worker to caregivers on nutrition, feeding characteristics, dietary composition, or food intake. Such advice might have followed evaluation of the patient's nutritional status, feeding behavior, dietary composition, or training on poor nutrition conditions. Depending on the availability of the data, I included assessment of quality and frequency of counseling to assess both skills and counseling acts of trained health workers.

I defined management practices for undernutrition as activities health workers perform towards management of poor nutritional status. Depending on data availability, this included assessment of undernutrition using anthropometric scores, assessment of micronutrient deficiency, treatment of

associated conditions, and treatment of undernutrition by prescription of supplements, or monitoring by growth charts, among other methods. The protocol for this systematic review was registered at PROSPERO http://www.crd.york.ac.uk/PROSPERO on February 6, 2013. The registration number for this review is CDR42013003800. It is also available at

http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42013003800.

2.2.2 Inclusion criteria

Based on the nature of the intervention and the outcome of interest, I included studies with nutrition training interventions. As for the study design, I included studies conducted as RCTs, cluster RCTs, quasi-experimental studies, and pre-post intervention longitudinal studies with or without comparison groups.

2.2.3 Exclusion criteria

I excluded any study where in the structure and/or quality of the training intervention provided to health workers was unclear from the description provided. I also excluded studies involving cadres of health workers outside the scope of the WHO that included community health volunteers, medical and nursing students, medical interns, and peers trained to provide specified health services. Non-interventional studies were also excluded from this review. They included cross-sectional studies, case reports, and non-interventional qualitative studies.

2.2.4 Data sources for existing reviews

I first searched for similar reviews or registered review protocols to avoid duplication and redundancy according to the standard review guidelines of the Center for Review and Dissemination (CRD) and Cochrane (90, 91). To this end, I searched such protocols listed in the Cochrane library and Cochrane Database of Systematic Reviews (CDSR). I used a similar approach to search other important databases for systematic reviews, including the Database of Abstracts of Reviews of Effects (DARE), the Educational Resources and Information Center (ERIC), the Campbell Library of Systematic Reviews, and the National Institute for Health and Clinical Excellence (NICE). Two independent researchers conducted the search for existing protocols and similar review articles.

2.2.5 Evidence search strategy

Two independent researchers conducted literature search based on the published review protocol. The search was conducted in five medical databases: PubMed/Medline, CINAHL, EMBASE, ISI Web of Knowledge, and WHO regional databases. The search was limited to a 15-year publication period (1997-2012), to ensure that I obtain enough evidence. Also, most of standard nutrition training interventions became more common after the publication of Integrated Management of Childhood Illnesses (IMCI) by WHO in 1997. For the PubMed/Medline database, I followed the search strategy outlined in the CDR register. Similar key words were then used to conduct searches in other selected databases. In order to ensure that I captured most of the relevant articles, I also conducted a hand search using references from key identified articles and archives of a journal with similar specialty-- the Journal of Human Resources for Health. **Figure 3** shows the results of searching and data management procedures according to the PRISMA check list (92).

A total of 3910 articles were retrieved from various sources. Of these, 646 studies were from PubMed/Medline. I retrieved a total of 3255 from other databases: 341 from CINAHL, 1543 from EMBASE, 1249 from ISI Web of Knowledge, and 122 from WHO Regional databases. A total of 9 studies were additionally obtained based on hand searches and review of specific journal databases.

On an initial screening of articles, I excluded a total of 3865 abstracts and articles due to duplication (598) between PubMed/Medline and other databases and those, which were irrelevant to the research question (3267). Of the 45 studies remaining, I further excluded 20 studies following a full-text assessment of eligibility. The reasons for exclusion were as follows: different outcome variable to that of interest (n=10), unclear or different intervention (n=5), unclear or different population (n=3), and different study design (n=2).

Figure 2: Flow diagram for the phases of systematic review 1
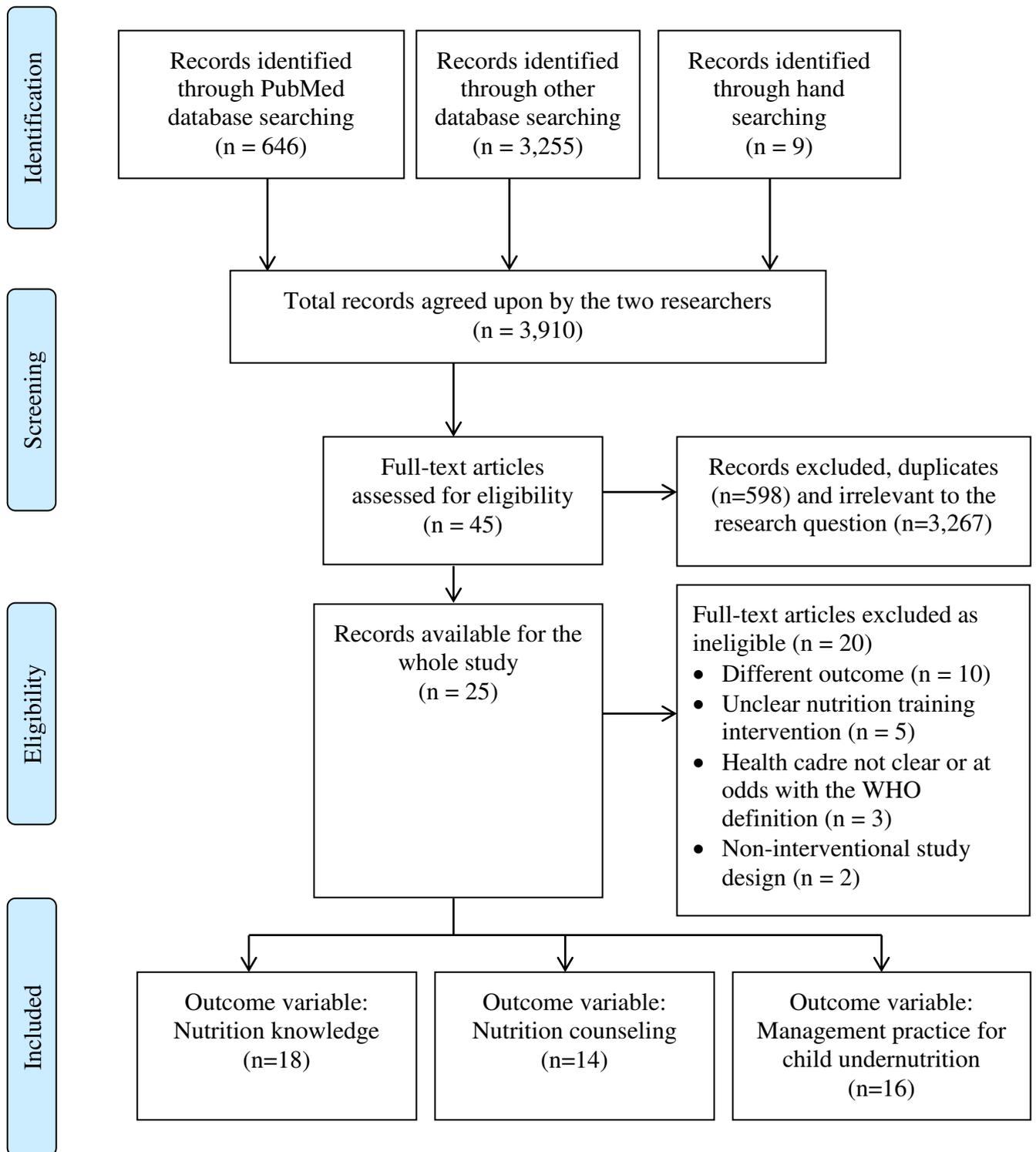
2.2.6 Risk of bias

I assessed risk of bias (RoB) for each cluster RCT (**Table 2**) and non-randomized studies (**Table 3**). I used the Cochrane the Cochrane risk of bias tool (91), to examine five types of RoB for randomized trials. These included selection, performance, attrition, detection, and reporting biases. Of the six cluster RCTs, only one study (75), had a high risk of selection and performance bias.

Table 2: Risk of bias assessment of RCTs and cluster RCTs

	Selection bias: allocation concealment	Performance bias: Blinding of participants and personnel	Detection bias: Blinding of outcome assessment	Attrition bias: Incomplete outcome data	Reporting bias: Selective reporting
Zaman S, 2008 (59)	+	+	+	+	+
Bassichetto K, 2008 (75)	−	−	+	+	+
Moore H, 2003 (53)	+	+	+	+	+
Pelto G, 2003 (80)	+	+	+	?	+
Santos I, 2001 (76)	+	+	+	+	+
Penny M, 2005 (83)	+	?	+	+	+

+   Indicates low risk of bias;
-   Indicates high risk of bias, and
?   Indicate unclear risk of bias

To assess quality and risk of bias for non-randomized studies, I used the Downs and Black scoring system (93). This tool has 27 checklists and is used to examine risk of bias for observation studies. I used the tool to examine reporting bias, external validity, internal validity-bias, internal validity-(confounding) selection bias, and power of the study (**Table 3**). Generally, the included non-randomized studies had good external validity and internal validity. However, ten out of eighteen of non-randomized studies included had low or unknown power to detect a clinical important effect of the intervention. This is due to the nature of the intervention and methods used to recruit their participants. Most of nutrition training used all available health workers, selected non-randomly, and without prior or unspecified sample size calculations.

Table 3: Risk of Bias (ROB) and methodological qualiy for non-randomized studies

Author, Year	Reporting (10)	External validity (3)	Internal validity -bias (7)	Internal validity (confounding) selection bias (6)	Power (1)
Palermo C, 2010 (94)	8	3	6	4	No
Lindorff-Larsen K, 2007 (78)	8	3	6	4	No
Puoane T, 2006 (95)	5	2	4	2	No
Hamer C, 2004 (96)	8	1	6	3	Yes
Edwards L, 1999 (97)	6	2	5	1	Yes
O'Mahony S, 2011 (98)	8	2	6	4	No
Hillenbrand K, 2002 (81)	9	2	6	4	No
Olsson U, 1998 (99)	8	3	6	4	Yes
Pedersen P, 2011 (100)	9	2	6	4	No
Gance-Cleverland B, 2008 (82)	8	3	4	4	No
Bjerrum M, 2011 (79)	5	2	4	2	No
Kennely S, 2011 (101)	9	3	6	4	Yes
Kennely S, 2010 (102)	9	3	6	4	Yes
Simoes E, 1997 (103)	9	2	5	4	No
Davies-Adetugbo A, 1997 (104)	9	3	6	4	Yes
Newes-Adeyi G, 2004 (105)	8	2	6	4	No
Stark C, 2011 (106)	9	3	7	2	Yes
Charlton K, 2009 (84)	9	3	6	4	Yes

2.2.7 Analysis strategy

The 25 studies were included for final analysis according to outcome variables. A single study could incorporate more than one outcome variable of interest. A total of 18 studies had health workers' nutrition knowledge as an outcome variable, 12 studies had health worker's nutrition counseling or general counseling skills as an outcome variable, and 16 studies had health worker's management practice as an outcome variable.

Of the 25 identified studies, six used a cluster RCT design (53, 59, 75, 76, 80, 83). One study had a controlled non-randomized trial design (77). A total of 18 studies, meanwhile, used a pre-post intervention evaluation and quasi-experimental design with or without a control group (78, 81, 82, 84, 94-106).

The duration of the intervention, population characteristics, and measurement of outcome variables differed across each of the included studies. Study design also differed from one study to another though they all aimed generally at a nutrition training intervention for health workers. To avoid the obvious risk of heterogeneity, I did not conduct meta-analysis. Instead, I sought to write a narrative summary to describe the results and stratified such description according to the outcome of interest.

2.3 Results

2.3.1 General description of the included studies

Out of 3910 retrieved studies, a total of 25 studies were included in this systematic review. These studies were conducted in countries from Africa, North and South America, Europe, Asia, and Australia (**Table 4**). The selected studies were also conducted in varied socio-economic levels, from least to most developed countries. Among the included studies, six were cluster RCTs, one was a controlled non-randomized trial, 17 were pre-post intervention evaluations, and one was a quasi-experimental design study. The included health worker cadres ranged from specialists in pediatric care to general practitioners, nurses, midwives and obstetricians, nutritionists, dieticians, and mid-level providers.

Nutrition training spanned to varying forms and duration. The most common standard used was the Integrated Management of Childhood Illnesses (IMCI) model, based on the "counsel the mother" and "nutrition-counseling" modules (59, 76, 80, 96, 103). Other training frameworks included the WHO standard counseling training modules (75, 77, 95, 104), tailored nutrition training using the Malnutrition Universal Screening Tool (MUST) (98, 101, 102), and nutrition training prepared specifically to suit the specific situation or context. Across training types, the lowest training duration was 4 hours (82), while the longest training duration was 6 weeks of online training (106).

The main outcomes of interest from the selected studies are presented in Table 4 according to the objectives. Health workers' nutrition knowledge after the nutrition training intervention was reported in a total of 18 studies: 3 RCTs (53, 75, 76), 1 controlled non-randomized trial (77), and 14 pre-post intervention studies (78, 79, 81, 82, 94, 96-99, 102-104). Counseling and communication skills of health workers who underwent the nutrition training were reported in 12 studies: 6 RCTs (53, 59, 75, 76, 80, 83) and 6 pre-post intervention studies (81, 82, 101-103, 105). A total of 16 studies reported health workers' management skills for child undernutrition after undergoing nutrition training. Among

such studies, 3 were RCTs (59, 75, 76), 1 was a controlled non-randomized trial (77), and 14 were pre-post intervention evaluation studies (84, 94-103, 106).

Table 4: Genaral description of studies included in the review

Author	Study design	Nutrition training intervention	Outcome of interest
Zaman S, 2008 (59) Pakistan	Cluster RCT	Nutrition counseling training using IMCI's 'Counsel the mother' module for five and a half days. It included infant feeding knowledge and practice sessions for the development of communication and counseling skills.	• Communication skills • Nutrition counseling • Management /practice
Bassichetto K, 2008 (75) Brazil	Cluster RCT	WHO's "Infant and young child feeding counseling: an integrated course". The training includes 8 hours of practical sessions. Out of 34 sessions, 8 were dedicated to breastfeeding, 6 to HIV and infant and young child feeding, 7 to complementary feeding, 10 to counseling, and 4 to general themes, making a total of 40 hours.	• Nutrition knowledge • Nutrition counseling • Undernutrition management/ Performance
Moore H, 2003 (53) UK	Cluster RCT	A nutrition training program was delivered to six intervention practices (health facilities). Emphasis of the training was on increasing motivation to improve quality of dietary consultations and providing them with practical skills adapted from behavior models. Included components in the 7.5-hour training were patients' assessment, education, and goal setting in issues of public health importance including drinking.	• Nutrition knowledge • Counseling
Pelto G, 2004 (80) Brazil	Cluster RCT	Physicians from the intervention group received a 20-hour training in a program derived from the IMCI nutrition counseling module. After training, they provided care to caregiver/child pairs who attended their centers.	• Counseling • Practice: communication skills
Santos I, 2001 (76) Brazil	Cluster RCT	Fourteen doctors received a 20-hour nutrition counseling training using IMCI's "counsel the mother" and "management of the sick young infant" modules. Based on local adaptation of IMCI feeding guidelines, the key feeding recommendations identified were as follows: increase breast and complementary feeding frequency, provide animal protein and micronutrient-rich foods, add oil to the food, and increase dietary diversity. Of the 20 hours of training, 40% was used for practical sessions in a health center.	• Nutrition knowledge • Nutrition counseling: • Undernutrition management skills /practice
Penny M, 2005 (83)	Cluster RCT	Interventions aimed to raise the nutrition profile of the health facility and to integrate nutrition	• Nutrition counseling

Peru		services into existing child health programs though training and provision of simple messages to caregivers. Training included demonstration of preparation of complementary foods and child's age-specific group sessions for their caregivers. The intervention also included training for health care workers to improve anthropometry skills. An accreditation system was also introduced for institutional change.	• Others: health seeking behavior:
Cattaneo A, 2001 (77) Italy	Controlled non-randomized trial	An 18-hour UNICEF "Breastfeeding, management, and health proportion in baby-friendly hospitals" course along with a 2-hour counseling session from the WHO's Breast feeding counseling course were implemented.	• Nutrition knowledge • Hospital performance
Palermo C, 2010 (94) Australia	Pre- post intervention study	Thirty-two dieticians were allocated to three intervention groups: two face-to-face groups and one rural video-linked group. The intervention involved a mentoring circle of experienced nutritionists and community-based dieticians. Each participant attended six 2-hours sessions every six weeks for a seven-month intervention period.	• Nutrition knowledge and competence
Lindorff-Larsen K, 2007 (78) Denmark	Pre- post intervention study	A follow-up study was conducted in 2004 and compared to a baseline study in 1997. Nutrition training and use of nutrition guidelines were being introduced and used between the two study intervals. Details of such training were not further elaborated.	• Nutrition knowledge
Puoane T, 2006 (95) South Africa	Pre- post intervention study (with a qualitative design)	A five-day course developed by the University of West Cape involved practice sessions, group work, role-plays, action plan development, key messages, and question and answer sessions. The course followed the principle of care set out by WHO for managing severe malnutrition. A total of 66 nurses from 11 referral hospitals underwent this course.	• Health workers' practice • Attitudes
Hamer C, 2003 (96) Gambia	Pre- post intervention study	Nutrition training for nurses was conducted using the IMCI training manual, "Assess and classify sick children aged 2 months to 5 years". Training materials were provided to nurses a week prior to training. The training included both theoretical and practical components towards assessing children with and without wasting and/or edema admitted to the hospital.	• Nutrition knowledge • Undernutrition management/ Practice
Edwards L, 1999 (97) UK	Pre- post intervention study	A total of 24 1-hour training sessions were held, reaching 189 staff. Each session consisted of factual information, a brainstorming session about what a pregnant woman eat, and a nutrition game involving calculation of daily requirement for folic acid.	• Nutrition knowledge • Health workers' practice

O'Mahony S, 2011 (98) UK	Pre- post intervention study	Nutrition training was delivered to nurse participants. It also included the use of the Malnutrition Universal Screening Tool (MUST).	• Nutrition knowledge • Health workers' practice
Hillenbrand K, 2002 (81) US	Pre- post intervention study	Forty-nine pediatric residents participated in a 4-part education series about breastfeeding delivered over 4 consecutive days. The education intervention was internally designed using additional inputs from lactation experts and fellow pediatricians. The training included lectures, discussions, role-playing, and group exercises.	• Nutrition knowledge • Nutrition counseling • Counseling and practice
Olsson U, 1998 (99) Sweden	Pre- post intervention study	Nutrition education for nurses was conducted for three months. It was based on the use of nutrition assessments including energy intake, clinical complications of inadequate energy intake, hospital food energy content, patients energy requirements, weighing patients and its necessity, reasons for weight loss during illness, and fluid management.	• Nutrition knowledge • Health workers' practice
Pedersen P, 2011 (100) Denmark	Pre- post intervention study	Nutrition training was conducted for nurses. It included five modules of 3-4 days duration using the theory of planned change. The training incorporated basic nutrition education elements such as risk assessment, consequences of malnutrition, and assessment of needs and responsibility.	• Health workers' practice
Gance-Cleverland B, 2008 (82) US	Pre- post intervention study	Thirty-five nurse practitioners received an intensive 4-hour Healthy Eating and Activity Together Clinical Practice Guideline (HEAT CPG) training session.	• Nutrition Knowledge • Nutrition counseling
Bjerrum M, 2011 (79) Denmark	Pre- post intervention study	Sixteen nurses participated in a special training program on nutrition. It was based on experimental theories and included five modules spanning 3-4 days, combining theories of planned change and nutrition issues.	• Nutrition knowledge
Kennely S, 2011 (101) Ireland	Pre- post intervention study	Seven general practitioners participated in the nutrition education program. A community dietician used a standardized presentation to conduct the program. The content of training included information on causes of malnutrition, effects of malnutrition, use of the MUST tool, practical dietary advice for patients with poor appetite, and evidence supporting the use of oral nutrition supplements (ONS).	• Nutrition counseling • Health workers' practice
Kennely S, 2010 (102) Ireland	Pre- post intervention study	An educational program incorporating the MUST training was implemented in 8 of 10 eligible primary practices, 7 private nursing homes, and 2 health centers. The training	• Nutrition knowledge • Nutrition counseling

		program was designed based on consultations with health professional groups, clinical guidelines from expert bodies, and current evidence for ONS use in community settings.	
Simoes E, 1997 (103) Ethiopia	Pre- post intervention study	A nine-day course using the pre-tested version of the IMCI course was provided to six clinic nurses. The training modules included assessment and classification of the sick child, treatment of the child, counseling the mother, and follow-up. Other modules included practical sessions in the clinic.	• Nutrition knowledge • Nutrition counseling • Health workers' practice
Davies-Adetugbo A, 1997 (104) Nigeria	Pre- post intervention study	A 1-day community mobilization with 6 hours of training on breastfeeding and child survival was conducted for health workers and mothers. The training was designed to include the importance of breast-feeding, exclusive breastfeeding, lactation maintenance, expressed breast milk, practical demonstration of attachment, suckling, expression of milk, and cup feeding. An intensive 2-day training was then conducted for health workers using a WHO/UNICEF 18-hour breastfeeding course manual. Training included practical, role-playing, and theory sessions.	• Nutrition and breastfeeding knowledge
Newes-Adeyi G, 2004 (105) US	Pre-post intervention study	A total of 35 women, infants, and children (WIC) staff underwent a 1-day intensive training program to improve their growth monitoring counseling and management of nutrition-related problems. The training included lectures, case studies, discussions, small group work, and role-plays.	• Nutrition counseling
Stark C, 2011 (106) US	Quasi-experimental design	A 6-week online professional development program for nutrition and health practitioners course was delivered to the intervention group. It was based on the PRECEDE-PROCEED health program planning framework involving assessment of underlying factors for a health problem and strategizing the intervention.	• Nutrition knowledge and skills
Charlton K, 2009 (84) Zambia	Pre- post intervention study	Eight out of sixteen health care workers received the Growth Monitoring and Promotion (GMP) training. Details of the training including duration and contents were not described.	• Nutrition knowledge • Nutrition practice

2.3.2 Effectiveness of the intervention to improve health workers' nutrition knowledge (a narrative summary)

Table 5 summarizes the 18 reviewed studies that included nutrition knowledge as the outcome variable. Among these studies, three used a cluster RCT design and were conducted in Brazil (75, 76) and the UK (53). A higher proportion of doctors who received the nutrition training intervention in the Brazilian studies had high post-training nutrition knowledge compared to doctors in the control group. In the UK-based RCT among general practitioners (GPs), nutrition training did not significantly change health workers' nutrition knowledge (53). However, GPs in the intervention group were 30% more likely to believe that their nutrition knowledge was up-to-date compared to their counterparts in the control group (P=0.001).

In an Italian controlled non-randomized trial with a comparison group (77), the mean nutrition knowledge score of nurses, midwives, and doctors increased from 0.41 to 0.72 in Group 1 and from 0.53 to 0.75 in Group 2 after the nutrition training. Compared to the delayed intervention control group, health workers in the intervention group registered a significant change in knowledge and skills (P<0.01) in a quasi-experimental study conducted in the US.

Fourteen studies were conducted using a pre-post intervention design in Australia (94), Denmark (78, 79), Gambia (96), UK (98), US (81, 82, 106), Sweden (99), Ireland (102), Ethiopia (103), Nigeria (104), and Zambia (84). In all of these studies, health workers' nutrition knowledge increased after nutrition training.

Table 5: The effectiveness of nutrition training to improve nutrition knowledge of health workers

Author, year	Study design	Health cadre	Nutrition training intervention	Comparison	Outcome: Nutrition knowledge
Bassichetto K, 2008 (75): Brazil	RCT: 31 professionals received intervention and 28 were the control	Pediatricians and nutritionists	WHO's "Infant and young child feeding counseling: an integrated course". The training includes 8 hours of practical sessions. Out of 34 sessions, 8 were dedicated to breastfeeding, 6 to HIV and infant and young child feeding, 7 to complementary feeding, 10 to counseling, and 4 to general themes.	Doctors and nutritionists in control group did not receive the training intervention.	Proportion of knowledge increase was more among HCWs in IG (e.g., Breastfeeding- IG-79.3%, CG 37% [P=0.004]; HIV and IYCF- IG-48.3%, CG-18.5% [P=0.049]; Complementary feeding- IG-69.0%, CG-37.0% [P=0.012]).
Moore H, 2003 (53): UK	Cluster RCT-Paired cluster randomized trial with pre- and post-intervention assessment	12 general practitioners	A training program was delivered to 6 intervention practices. Emphasis was on increasing motivation to improve quality of dietary consultations and providing practical skills adapted from behavior models. A 7.5-hours training included patients' assessment, education, and goal setting in issues of public health importance including drinking.	6 control practices did not receive nutrition training	IG- trained practitioners were 30% (95% CI 12-50, P=0.001) more likely to believe that their knowledge was up to date than practitioners in IG. There was no statistical significance difference in actual knowledge between IG and CG.
Santos I, 2001 (76): Brazil	RCT of 28 government health centers	28 medical doctors	A total of 14 doctors in the intervention group received a 20-hour nutrition counseling training and practice using IMCI's "counsel the mother" and "management of the sick young infant" modules. The key recommendations identified were as follows: increase breast and complementary feeding frequency, provide animal protein and micronutrient-rich foods, add oil to the food, and increase dietary diversity.	14 doctors recruited for CG did not receive training.	Doctors from IG correctly answered 83% (95% CI 65-100) of 77 questions on practical situations in the IMCI guidelines compared to 68% (95% CI 48-88) in the CG (P=0.02).
Cattaneo A, 2001 (77):	Controlled non-	Nurses, midwives,	An 18-hour UNICEF "Breastfeeding, management, and health proportion in baby-	Post-training evaluation	In Group 1, nutrition knowledge went up from a mean score of 0.41 to 0.66 to 0.72.

Italy	randomized study	obstetricians, and physicians	friendly hospitals" course along with a 2-hour counseling session from the WHO Breast-feeding counseling course were implemented.		In Group 2, nutrition knowledge went from 0.53 to 0.53 to 0.75.
Palermo C, 2010 (94): Australia	Pre-post intervention study	Nutritionists and dieticians	A total of 32 dieticians were allocated to three IGs: two face-to-face groups and one rural video-linked group. The intervention involved a mentoring circle of experienced nutritionists and community-based dieticians. Each participant attended six 2-hours sessions every six weeks for a seven-month intervention period.	Pre-post intervention comparison (qualitative and quantitative)	Reported competency score increased post-training/mentoring. An increase in post-intervention measures was also reported: (69.1[13.8] to 79.3[12.1], P<0.001).
Lindorff-Larsen K, 2007 (78): Denmark	Pre-post intervention study	Doctors and nurses	A follow-up study was conducted in 2004 and compared to a baseline study in 1997. Nutrition training and guidelines were being introduced and used between the two study intervals. Details of such training were not further elaborated.	A cross-sectional study, post-trainings and post-guideline application	About two-thirds of doctors and nurses expressed that their education nutrition was sufficient at post-intervention. Significantly fewer health workers lacked methods to identify undernutrition (P<0.001) and difficult-to-identify patients in need of nutrition support (P<0.001) at post-intervention.
Hamer C, 2003 (96): Gambia	Pre-post intervention study	Registered nurses and auxiliary nurses	Nutrition training for nurses was conducted using the IMCI training manual, "Assess and classify sick children aged 2 months to 5 years". It included both theoretical and practical components of assessing children with and without wasting and edema.	Post-training evaluation	Nurses showed good knowledge and performance after the completion of training.
Edwards L, 1999 (97): UK	Pre-post intervention study	Midwives, physicians, dieticians, and nurses	A total of 24 1-hour training sessions were held for 189 staff. Each session consisted of factual and brainstorming sessions about what a pregnant woman eats, and a nutrition	Post-training evaluation	Health workers' nutrition knowledge improved post-training.

			calculation of daily requirement for folic acid.		
O'Mahony S, 2011 (98): UK	Pre-post intervention study	Nursing staff	Nutrition training was delivered to nurse participants on the use of the Malnutrition Universal Screening Tool (MUST).	Post-training evaluation	A non-significant difference in post-training nutrition knowledge was observed (Mean [SD] knowledge score 21[6.7] vs. 23[6.2]). A significant difference was observed in sub-analyses by bands. Nurses were more aware that malnutrition was a significant problem for the National Health Service post-training (P<0.027).
Hillenbrand K, 2002 (81): US	Pre-post intervention study	Pediatric residents	A total of 49 pediatric residents participated in a 4-part education series about breastfeeding over 4 consecutive days. It included lectures, discussions, role-playing, and group exercises. The education intervention was internally designed by the authors using inputs from lactation experts and fellow pediatricians.	Post-training evaluation	Mean composite knowledge score was 80% post intervention compared to 69% pre-intervention, representing an 11% increase (P<0.01).
Olsson U, 1998 (99): Sweden	Pre-post intervention study	Nurses	Nutrition education for nurses was conducted for three months. It was based on the use of nutrition assessment including energy intake, clinical complications of inadequate energy intake, hospital food energy, patients' energy requirements, weighing patients and its necessity, reasons for weight loss during illness, and fluid management.	Post-training evaluation	69% of nurses could calculate a patient's energy requirement post-training compared to 24% pre-training (P<0.01). Compared to pre-training, more nurses knew the energy content of hospital food (61% vs. 45%, P<0.05), knew how to handle enteral infusion equipment (55% vs. 6%, P<0.01), and found it easy to assess patients' energy needs (56% vs. 24%, P<0.01).
Gance-Cleverland B, 2008 (82): US	Pre-post intervention study	Nurse practitioners	A total of 35 nurse practitioners received an intensive 4-hour Healthy Eating and Activity Together Clinical Practice Guideline (HEAT CPG) training session.	Post-training evaluation	Nutrition knowledge post training improved, including on assessment of growth (P<0.001), assessment of family history (P<0.001), and assessment of

					physical activity (P<0.001). Practitioners' nutrition recommendation knowledge also improved post-training compared to pre-training.
Bjerrum M, 2011 (79): Denmark	Pre-post intervention study	Nurses	A total of 16 nurses participated in a special training program on nutrition. It was based on experimental theories. A total of five modules lasting 3-4 days were included. They combined theories of planned change and nutrition issues.	Post-training evaluation	A short-duration training program enhanced nurses' awareness of nutrition care, management through assessment and monitoring, their management roles, and approach to clinical nutrition.
Kennely S, 2010 (102): Ireland	Pre-post intervention study	General practitioners (GPs) and nurse practitioners	An educational program incorporating Malnutrition Universal Screening Tool (MUST) training was implemented in 8 of 10 eligible primary practices, seven private nursing homes, and two health centers. The training program was designed based on consultations with health professional groups, clinical guidelines from expert bodies, and current evidence for oral nutrition supplementation (ONS) use in community settings.	Post-training evaluation	Nutrition knowledge improved across three evaluation points (P<0.05). For specific groups, a significant improvement in knowledge score was also observed among general practitioners (P<0.001) and nurses (P<0.001).
Simoes E, 1997 (103): Ethiopia	Pre-post intervention study	Clinic nurses	Six clinic nurses received a nine-day course using the pre-tested version of the IMCI course. The training modules included assessment and classification of a sick child, treatment of the child, counseling the mother, and follow-up. Other modules included practical sessions in the clinic.	Post-training evaluation	After training, nurses could recognize visible severe wasting with a 67% sensitivity and 99% specify; conjunctiva pallor for anemia at 45% sensitivity and 94% specificity; and bipedal edema with 69% sensitivity and 98% specificity
Davies-Adetugbo A,	Pre-post intervention	Community health	A 6-hour training on breastfeeding and child survival was conducted for health workers	Post-training evaluation	Trained health workers had a significantly higher aggregate knowledge score

1997 (104): Nigeria	study	extension workers	and mothers. The training included the importance of breast-feeding, exclusive breastfeeding, lactation maintenance, expressed breast milk, practical demonstration of attachment, suckling, expression of milk, and cup feeding. An intensive 2-day training was then conducted for health workers using a WHO/UNICEF 18-hour breastfeeding course manual.		compared to their untrained counterparts (9.4[9.1-9.7] vs. 7.6[6.6-8.6], P<0.001).
Stark C, 2011 (106): US	Quasi-experimental design using intervention and delayed intervention comparison group	Nutrition and health professionals	An online professional development program for nutrition and health practitioners course was given to the intervention group for 6 weeks. It was based on the PRECEDE-PROCEED health program planning framework involving assessment of underlying factors for a health problem and strategizing the intervention.	Delayed intervention control group	Compared to the control group, the intervention group reported significant positive changes (P<0.01) on knowledge and skills scores.
Charlton K, 2009 (84): Zambia	Pre-post intervention study	Health workers for Growth Monitoring and Promotion	Eight out of 16 HCWs received the Growth Monitoring and Promotion training.	Post-training evaluation	Compared to untrained HCWs, trained HCWs could correctly define growth monitoring and promotion (P<0.001).

2.3.3 Effectiveness of intervention to improve nutrition counseling skills of health workers (a narrative summary)

Table 6 shows the result of the 12 reviewed studies with nutrition counseling as an outcome variable following nutrition training of health workers. Of these studies, six were cluster RCTs (75, 76, 80, 107), and three were conducted in Brazil among doctors and pediatricians. Across all three studies, a significantly higher proportion of doctors in the intervention group had better post-training counseling skills and performed more nutrition counseling compared to the respective control group. Physicians underwent the training intervention also showed higher mean communication skill scores compared to untrained physicians ($P<0.01$) (80). In a Pakistani cluster RCT among lady health visitors (LHVs) working at a health facility as mid-level providers, 82% of participants in the intervention group registered improved post-training communication skills compared to 51% in the control group ($P=0.015$). In this study, a higher proportion of trained LHVs reported increased counseling skills compared to their counterparts. GPs with nutrition training in the UK study (53), meanwhile, were 30% more likely to provide dietary advice that was completely appropriate compared to their counterparts ($P=0.01$). In Peru (83), twice as many mothers in the intervention group received postpartum nutrition advice compared to their control group counterparts following the nutrition training intervention for their health workers ($P=0.02$).

A total of six studies using pre-post intervention evaluation of nutrition training of health workers reported nutrition counseling skills as an outcome variable. These studies were conducted in the US (81, 82, 105), Ireland (101, 102), and Ethiopia (103). In all six studies, nutrition and general counseling skills of health workers improved after nutrition training.

Table 6: Effectiveness of nutrition training to improve nutrition counseling and counseling skills of caregivers

Author, year	Study design	Health cadre	Intervention	Comparison	Outcome: Nutrition counseling
Zaman S, 2008 (59): Pakistan	Cluster RCT: 18 health centers were assigned to IG and a similar number to CG	Lady health visitors (LHVs)	Nutrition counseling training using IMCI's "Counsel the mother" module for five and a half days. It included infant feeding knowledge and practice sessions to develop communication and counseling skills.	Health centers of the control group without counseling training for health workers	Counseling: Asking about feeding practices and paying attention to answers: IG- 50%, CG-25%, P=0.056; Praising mothers for positive action: IG-37%, CG-8%, P=0.006. Appropriate recommendations to specific changes with explanation: IG-29%, CG-4%, P=0.01. Communication skills: IG-82%, CG-51%, P=0.015
Bassichetto K, 2008 (75): Brazil	RCT: 31 professionals received intervention and 28 were recruited as a control group.	Pediatricians and nutritionists	WHO's "Infant and young child feeding counseling: an integrated course" was administered. The training includes 8 hours of practical sessions. Out of 34 sessions, 8 were dedicated to breastfeeding, 6 to HIV and infant and young child feeding, 7 to complementary feeding, 10 to counseling, and 4 to general themes.	Participants recruited for the control group did not receive the training intervention	Counseling: IG-51.7%, CG-22.2% (P=0.004).
Moore H, 2003 (53): UK	Cluster RCT- Paired cluster randomized trial with pre- and post-intervention evaluation	General practitioners	A training program was delivered to 6 intervention practices. Emphasis was on increasing motivation to improve quality of dietary consultations and providing practical skills adapted from behavior models. A 7.5-hours training included patients' assessment, education, and goal setting in issues of public health importance including drinking.	A total of six control practices did not receive nutrition training	Counseling: Trained practitioners were 30% (95% CI 7-53, P=0.01) more likely to provide dietary advise that was completely appropriate compared to the control group.
Pelto G, 2003 (80): Brazil	Cluster RCT of 28 municipal health centers	Doctors	Physicians from the intervention group received a 20-hour training in a program derived from the IMCI nutrition-counseling module. After training, they	Physicians in the control group received a clinical	Counseling: Trained providers engaged more in nutrition counseling (only 9[24%] consultations of IG participants did not include advice compared to 14 [43%] among CG participants:

			provided care to caregiver/child pairs attending their centers.	refresher course but not on nutrition counseling	P<0.013); gave 81 messages compared to 20 of untrained ones (P<0.002); gave more message specific to foods, preparations, and feeding practices compared to untrained ones (P<0.01). Communication skills: Mean communication skills score of trained physicians was 3.94 (SD 1.68) vs. 1.38 (SD 1.02) for untrained ones (P<0.01).
Santos I, 2001 (76): Brazil	RCT of 28 government health centers	28 medical doctors	A total of 14 doctors of the IG received a 20-hour nutrition counseling training and practice using IMCI's "counsel the mother" and "management of the sick young infant" modules. The key recommendations identified were as follows: increase breast and complementary feeding frequency, give animal protein and micronutrient-rich foods, add oil to the food, and increase dietary diversity.	14 doctors recruited for the control group did not receive the training	Counseling: 83% of mothers in IG compared to 49% of mothers in CG received nutrition counseling (P<0.001).
Penny M, 2005 (83): Peru	Cluster RCT of 12 health facilities serving periurban areas	Health workers in selected health facilities	The intervention included training for HCWs to improve anthropometry skills. An accreditation system was also introduced for institutional change. Also it included demonstration of preparation of complementary foods and child's age-specific group sessions for caregivers.	HCWs and caregivers of CG did not receive the training intervention	Counseling: Twice as many mothers in IG received nutrition advice after birth compared to those in CG (52% vs. 24%, P=0.02). Greater impacts on counseling were observed at 4 and 18 months post-intervention (P<0.002)
Hillenbrand K, 2002 (81): US	Pre-post intervention study	Pediatric residents	A total of 49 pediatric residents participated in a 4-part education series about breastfeeding over 4 consecutive days. The training included lectures, discussions, role-playing, and group exercises. The education intervention was designed using additional inputs from	Post-training evaluation	Counseling: Residents showed an increased knowledge in advising mothers concerning low milk supply (P=0.045), infections including mastitis (P=0.002), or abscess (P<0.001) Counseling and practice: Residents showed significant increases in counseling on signs of

			lactation experts and fellow pediatricians.		breast feeding adequacy (P=0.012) and managing lactation problems correctly (P=0.004).
Gance-Cleverland B, 2008 (82): US	Pre-post intervention study	Nurse practitioners	A total of 35 nurse practitioners received an intensive 4-hour Healthy Eating and Activity Together Clinical Practice Guideline (HEAT CPG) training session.	Post-training evaluation	Counseling: Participants reported a significant improvement in behavior modification techniques (P<0.001) and practitioners' counseling (P<0.001).
Kennelly S, 2011 (101): Ireland	Pre-post intervention study	General practitioners-doctors	Seven GPs participated in the nutrition education program. The content of training included causes of malnutrition, effects of malnutrition, the use of the Malnutrition Universal Screening Tool (MUST), practical dietary advice for patients with poor appetite, and evidence supporting the use of oral nutrition supplements (ONS).	Post-training evaluation	Counseling: Basic dietary advice provided by a health professional increased significantly post-training (90% vs. 26%, P<0.001).
Kennelly S, 2010 (102): Ireland	Pre-post intervention study	General practitioners (GP) and nurse practitioners	An educational program incorporating the MUST training was implemented in 8 of 10 eligible primary practices, seven private nursing homes, and two health centers. The training program was designed based on consultations with health professional groups, clinical guidelines from expert bodies, and current evidence for ONS use.	Post-training evaluation	Counseling: About 80% of HCWs reported always providing nutrition advice to patients.
Simoes E, 1997 (103): Ethiopia	Pre-post intervention study	Clinic nurses	A nine-day course using the pre-tested version of the IMCI course was provided to six clinic nurses. The training modules included assessment and classification of sick child, treatment of the child, counseling the mother, and follow-up. Other modules included practical sessions in the clinic.	Post-training evaluation	Counseling: Trained health workers provided feeding advice rated as 'good' by 78%, 'fair' at 18% and 'poor' at 4%.

| Newes-Adeyi G, 2004 (105): US | Pre-post intervention study | Health workers of a special Nutrition Program | A total of 35 health workers underwent a 1-day intensive training program to improve their growth monitoring counseling and management of nutrition-related problems. The training included lectures, case studies, discussions, small group work, and role-plays. | Post-training evaluation | Counseling: Compared to pre-training, there was a significant change in elicitation (P<0.001) and negotiation proficiency (P=0.07). The level of engagement in discussing provider suggestions for follow-up strategies increased from 1.8 to 2.3 (P<0.01) and the overall responsiveness level increased from a mean of 2.4 to 2.8 (P<0.07). |

2.3.4 Effectiveness of intervention to improve health workers' management practices for child undernutrition (a narrative summary)

Table 7 summarizes the results of the 16 reviewed studies reporting management of undernutrition and management practices as outcome variables following the nutrition training intervention. Within these studies, two of the three cluster RCTs were conducted in Brazil among medical doctors, pediatricians, and nutritionists (75, 76). Doctors in the intervention group were more likely to report improved post-intervention practices in managing child undernutrition compared to their counterparts. In the Pakistani study, trained LHVs were more likely to plot children's weights, discuss appropriate foods with caregivers, and check mothers' understanding of imparted nutrition knowledge compared to their counterparts in the control group. In an Italian controlled non-randomized trial (77), all hospitals improved their compliance with WHO's "Ten Steps to Successful Breastfeeding" after undergoing the WHO baby-friendly hospital and counseling course.

Nutrition and health professionals in the quasi-experimental design study in the US exhibited better nutrition management skills after the six-week online nutrition training (106). Compared to health workers in the delayed intervention control group, those in the intervention group registered significant positive changes on knowledge and skills scores (P<0.01).

Eleven pre-post intervention studies on nutrition training of health workers were conducted in Australia (94), South Africa (95), Gambia (96), UK (97, 98), Sweden (99), Denmark (100), Ireland (101, 102), Ethiopia (103), US, and Zambia (84). In all these studies, management practices and competence of health workers improved after the intervention compared to pre-nutrition training intervention levels.

Table 7: Effectiveness of nutrition training to improve nutrition management practices and competence of health workers

Author, year	Study design	Health cadre	Intervention	Comparison	Outcome
Zaman S, 2008 (59): Pakistan	Cluster RCT: 18 health centers were assigned IG and a similar number were assigned to CG	Lady health visitors	Nutrition counseling training using IMCI's "Counsel the mother" module for five and a half days. It included infant feeding knowledge and practice sessions for development of communication and counseling skills.	HCWs of the CG received no counseling training	Practice: HCWs in the intervention group were more likely to plot the weight of a child, discuss foods appropriate to the child, and check if mothers understood information provided compared to the control group.
Bassichetto K, 2008 (75): Brazil	RCT: 31 professionals recruited to IG and 28 for CG	Pediatricians and nutritionists	WHO's "Infant and young child feeding counseling: an integrated course" was implemented. The training includes 8 hours of practical sessions. Out of 34 sessions, 8 were dedicated to breastfeeding, 6 to HIV and infant and young child feeding, 7 to complementary feeding, 10 to counseling, and 4 to general themes.	HCWs in the CG did not receive the training intervention	Performance: IG participants improved their dietary anamnesis during consultations after intervention (P<0.001).
Santos I, 2001 (76): Brazil	RCT of 28 government health centers assigned to either IG or CG	28 medical doctors	A total of 14 doctors of IG received a 20-hour nutrition counseling training and practice using IMCI's "counsel the mother" and "management of the sick young infant" modules. The key recommendations identified were as follows: increase breast and complementary feeding frequency, provide animal protein and micronutrient-rich foods, add oil to the food, and increase dietary diversity.	Doctors in the CG did not receive counseling training	Practice: Doctors from IG were more likely to assess child's complementary feeding, assess breast-feeding, use good communication skills, and use and provide mothers with a card compared to CG.
Cattaneo A, 2001 (77): Italy	Controlled non-randomized	Nurses, midwives, obstetricians, and	An 18-hour UNICEF "Breastfeeding, management, and health proportion in baby-friendly hospitals" course along with a 2-hour counseling session from the WHO Breast feeding counseling course was	Post-training evaluation	Performance: All hospitals improved their compliance with the WHO Ten Steps to Successful Breastfeeding.

		physicians	implemented.		
Palermo C, 2010 (94): Australia	Pre-post intervention study	Nutritionists and dieticians	A total of 32 dieticians were allocated to three intervention groups: two face-to-face groups and 1 rural video-linked group. The intervention involved a mentoring circle of experienced nutritionists and community-based dieticians. Each participant attended six 2-hours sessions every six weeks for a seven-month intervention period.	Pre-post intervention comparison (qualitative and quantitative)	Nutrition competence: Reported competency scores increased post training/mentoring. An increase in post-intervention measures was also observed: (69.1[13.8] to 79.3[12.1], P<0.001).
Puoane T, 2006 (95): South Africa	Pre-post intervention study (with a qualitative design)	Nurses	A 5-days course developed by the University of West Cape was administered. It involved practice sessions, group work, role-plays, development of an action plan, key messages, and question and answer sessions. The course followed the principle of care set out by WHO for managing severe malnutrition.	Post-intervention (training)	Practice: In-patient care for malnutrition management improved after the training. This included adequate follow-up on the ten steps to management of malnutrition.
Hamer C, 2003 (96): Gambia	Pre-post intervention study	Registered and auxiliary nurses	Nutrition training for nurses was conducted using the IMCI training manual, "Assess and classify sick children aged 2 months to 5 years". It included both theoretical and practical components of assessing children with and without wasting and/ or edema admitted to the hospital.	Post-training evaluation	Practice: In assessing undernutrition, nurses showed a 56% sensitivity, 95% specificity, and 56% positive predictive value (PPV).
Edwards L, 1999 (97): UK	Pre-post intervention study	Midwives, physicians, dieticians, and nurses	A total of 24 1-hour training sessions were held, reaching 189 staff. Each session consisted of factual information, a brainstorming session about what a pregnant woman eats, and a nutrition game involving calculation of daily requirement for folic acid.	Post-training evaluation	Practice: In a nutrition game, a high average intake of folic acid was observed in the chosen food items. It ranged from 244-500 micrograms compared to only 219 micrograms shown in average in census data on the same population.
O'Mahony S, 2011 (98): UK	Pre-post intervention study	Nursing staff	Nutrition training was conducted with nurse participants. It also included the use of the Malnutrition Universal Screening Tool (MUST).	Post-training evaluation	Practice: 94% of nurses weighed patients on admission post-training compared to 74% before (P<0.001).

Olsson U, 1998 (99): Sweden	Pre-post intervention study	Nurses	Nutrition education for nurses was conducted for three months. Training was based on the use of nutrition assessments including energy intake, clinical complication of inadequate energy intake, hospital food energy content, patients' energy requirements, weighing patients and its necessity, reasons for weight loss during illness, and fluid management.	Post-training evaluation	Practice: Compared to pre-training, during post-training, nurses were more likely to use food forms to document food intake (P<0.01).
Pedersen P, 2011 (100): Denmark	Pre-post intervention study	Nurses	Nutrition training was conducted for nurses. It included five modules spanning 3-4 days using the theory of planned change. The intervention involved basic nutrition education elements such as risk assessment, consequences of malnutrition, and assessment of needs and responsibility.	Post-training evaluation	Practice: After the training, more patients reported eating difficulties to staff (P=0.01), none reported not receiving help in cutting their food (P=0.014), fewer had difficulty in chewing (P=0.01), and fewer reported not receiving food they did not order (P=0.01).
Kennelly S, 2011(101): Ireland	Pre-post intervention study	General practitioners-doctors	Seven general practitioners participated in the nutrition education program. A community dietician used a standardized presentation to conduct the program. The content of training included information on causes of malnutrition, effects of malnutrition, the use of MUST, practical dietary advise to patients with poor appetite, and evidence supporting the use of oral nutrition supplements (ONS).	Post-training evaluation	Practice: About 62% completed a nutrition screening tool (MUST) on referral to a community dietician compared to 0% pre-intervention (P<0.001). A greater proportion of patients with high risk of malnutrition were prescribed ONS post-training compared to pre-training (88% vs. 37%, P<0.001).
Kennelly S, 2010 (102): Ireland	Pre-post intervention study	General practitioners (GP) and nurse practitioners	An educational program incorporating MUST training was implemented in 8 of 10 eligible primary practices, 7 private nursing homes, and 2 health centers. The training program was designed based on consultations with health professional groups, clinical guidelines from expert bodies, and current	Post-training evaluation	Practice: Management of malnutrition improved post training. About 69% of HCWs weighed patients more frequently and 80% reported on the usefulness of MUST.

			evidence for ONS use in community settings.		
Simoes E, 1997 (103): Ethiopia	Pre-post intervention study	Clinic nurses	A nine-day course using the pre-tested version of the IMCI course was provided to six clinic nurses. The training modules included assessment and classification of a sick child, treatment of the child, counseling the mother, and follow up. Other modules included practical sessions in the clinic.	Post-training evaluation	Practice: Compared to pediatricians, the trained nurses could diagnose malnutrition and anemia classified as severe or some malnutrition at a sensitivity of 85% and specificity of 96%.
Stark C, 2011 (106): US	Quasi-experimental design	Nutrition and health professionals	An online professional development program for nutrition and health practitioners course was given to the intervention group for 6 weeks. It was based on the PRECEDE-PROCEED health program planning framework involving assessing underlying factors for a health problem and strategizing the intervention.	Delayed intervention control group	Nutrition management skills: Compared to the control group, the intervention group reported positive changes (P<0.01) on knowledge and skills scores.
Charlton K, 2009 (84): Zambia	Pre-post intervention study	Health workers of Growth Monitoring and Promotion	Eight out of sixteen HCWs received the Growth Monitoring and Promotion (GMP) training. Details of the training including duration and contents were not explained.	Post-training evaluation	Practice: Trained HCWs could correctly interpret growth cards and complete the under-five card compared to their untrained counterparts (P<0.05).

IG- Intervention group, CG- control group, HCWs- health care workers

2.4 Discussion

This is the first systematic review to examine the effectiveness of in-service nutrition training to improve health workers' nutrition knowledge, nutrition counseling, and undernutrition management practices. In this review, I reviewed a total of 25 studies reporting on nutrition training interventions. Across all three outcome variables, significant post-intervention improvements were reported. First, in-service nutrition training improved health workers' nutrition knowledge. Second, the counseling skills and competence of health workers were also improved after in-service nutrition training. Third, the training intervention improved child undernutrition management practices of participating health workers.

A total of 18 studies, including 5 with a cluster RCT design, showed significant post-nutrition training improvements in health workers' nutrition knowledge. These studies were conducted in areas of varying social and economic levels and geographic characteristics. Health workers might also have been exposed to nutrition education during their college training (52). However, previous studies have indicated that such training is inadequate or not in keeping with the clinical reality encountered in practice (71, 72). Lack of nutrition knowledge might also cause them to refrain from providing nutrition counseling and care to their clients (52). Sometimes doctors feel that it is the duty of nurses or other cadres below them to provide nutrition counseling and care due to their lack of adequate nutrition knowledge. To improve knowledge of such health workers, it is important to expose them to in-service nutrition training tailored to their environment, context, and health cadre (71). This will help to boost their competence and confidence in management of nutrition-related conditions including undernutrition.

In this systematic review, a total of 12 studies, including 6 cluster RCTs, showed a significant improvement in counseling skills among health workers with in-service nutrition training. Nutrition training would thus seem to be effective in improving health workers' nutrition knowledge. Nutritionally informed health workers may be more confident to address nutrition-related

conditions in their patients (108). Such health workers may be better equipped to provide appropriate advice and counseling to their clients. The prevailing attitude towards nutrition counseling among medical doctors and pediatricians that such functions are not within their job description might also change after nutrition training. In this way, such trained health workers would be more likely to provide nutrition counseling compared to the untrained ones (109). In line with the health belief model, nutrition knowledge provided to the health workers through nutrition training may influence counseling behavior (87). Further, according to Bandura's social learning theory, such behavior or attitude change is mediated through cognitive processes and thus is learned through imitating and observing the actions of others (87). Accordingly, the reward that health workers can gain from their nutrition counseling actions, such as better nutritional status or feeding practices in those they treat, may reinforce their counseling actions, thus making it a sustained habit. In this way, the quality of health workers with regard to nutrition counseling might be expected to improve.

This review showed that health workers' undernutrition management practices improved when they received in-service nutrition training. A total of 16 intervention studies, including 3 cluster RCTs, showed a significant improvement in management practices for child undernutrition after nutrition training. Barriers to effective management of child undernutrition include lack of nutrition knowledge and counseling skills among health providers (74). Such barriers can be ameliorated when health workers receive appropriate and tailored in-service nutrition training suited to their context and cadre.

Findings from this review should be carefully considered in the context of two primary limitations. First, the results are not based on meta-analysis to calculate the overall effect size of the intervention for each outcome variables. This was due to variations in the study designs and measurements used for outcome variables, and to differences in the competence, experience, and cadres of participating health workers. Such variations could have resulted in high heterogeneity. Hence, instead of meta-analyses, I explained each study separately in a narrative summary stratified

by outcome variable. Although I did not pool the results, individual studies showed a significant effect of nutrition interventions on outcome variables.

Second, the included studies differed in the intervention's length and content. This might have caused differences in the measured outcome variables. However, most of the studies used standard nutrition training frameworks for health workers including the IMCI nutrition counseling training module, breast feeding counseling training modules by both WHO and UNICEF, MUST training modules, and other comparable training based on formative research. Despite such differences, each study showed a significant improvement in one or more of the outcome variables.

Despite its limitations, findings thus presented may help decision makers to plan and conduct in-service nutrition training for health workers, an important building block towards a strong foundation for any health system. This review is the first of series papers on the effectiveness of nutrition training of health workers. It is also the first systematic review on the effectiveness of nutrition training for health workers on their nutrition knowledge, nutrition counseling, and undernutrition management skills. The other paper in the series found that, nutrition training of health workers improved feeding frequency, energy intake, and dietary diversity of children aged six months to two years (50).

In conclusion, in-service nutrition training of health workers improves their nutrition knowledge, nutrition and general counseling skills, and undernutrition management skills. Such nutrition training within the context of their practice is of paramount importance due to inadequate nutrition training in the health workers' mainstream medical and nursing education. In-service nutrition training can take different forms such as compulsory continuing medical education (CME), nutrition seminars, workshops, or non-compulsory continuing professional education CPD. Whatever form it takes, nutrition training has the potential to improve the quality of health workers, making them more confident and competent in this key area and thus contributing to positive changes in population nutrition.

Chapter 3:

Effectiveness of nutrition training of health workers toward improving caregivers' feeding practices for children aged six months to two years: A systematic review

3.1 Background

Undernutrition is responsible for more than one-third of child deaths globally (110), and it is more prevalent in low- and lower-middle-income countries (111). Poverty has remained an important underlying cause of poor nutrition status among children in these regions (112, 113). It has been cited as a factor behind food insecurity (114, 115), low maternal education, poor access to healthcare (116), and burden of diseases (117), each of which mediates poor child nutrition status. A disadvantaged socioeconomic position may also feed into caregivers' poor feeding practices with regard to their children (118, 119). Poor feeding practices include low dietary diversity, feeding frequency, and energy intake (120-122).

Poor child feeding practices are caused by a myriad of factors. They are associated with cultural factors that may create local tendencies toward selection of low-quality complementary foods (123, 124); taboos (124); and restrictive traditional beliefs (125). Social factors including caregivers' poor knowledge on nutrition and lack of knowledge on food diversity in their environment may also correlate with poor feeding practices (3). Such factors may result in low dietary diversity, low feeding frequency, and low food and energy intake for children.

Caregivers' nutrition education can help to clear cultural and tradition-based misconceptions, restrictive traditional beliefs on feeding practices, and improve their general nutrition knowledge (57). Feeding practices can thus be improved if knowledgeable health workers treat and counsel them on proper feeding practices and monitor their progress closely (80). Nutritionists and dieticians can, of course, perform such counseling when they are available (126-128). However, health workers equipped with such specialized skills may not be in sufficient supply for routine care in many developing countries (129, 130), leaving health workers who have only general nutrition knowledge to provide such care. Medical doctors, nurses, midwives, and midlevel providers are not always trained to perform such tasks and may not have adequate or practical knowledge to counsel and treat undernutrition (131). Nutrition training for these cadres can help to bridge such knowledge gaps.

Available evidence supports that; nutrition training of health workers can improve feeding practices and thus child undernutrition. Previous randomized controlled trials (RCTs) found higher levels of nutrition knowledge and counseling behavior among health workers who received nutrition training (80, 132, 133). Nutrition knowledge among caregivers improved in turn when they were frequently counseled by health workers who received nutrition training (80). Nutrition counseling also improved caregivers' knowledge in food preparation (59, 134) and healthy feeding behaviors (135). As a result, caregivers have higher chance of improving their children's feeding frequency (136), dietary diversity (83), protein, and energy intake (55, 134). Such elements of feeding practice are essential to improving children's nutrition status (56, 137).

Opportunities for routine nutrition counseling can be identified in existing health care frameworks. Globally, about 88% of pregnant mothers had at least one antenatal visit while 50% had a postnatal visit to a health care facility in 2012 (138). These represent potential opportunities for nutrition counseling by trained health workers. Only 57% of mothers had a skilled attendant at their children's birth (138). However, for such mothers who delivers at home, there is also room for home-based nutrition counseling using community health workers or peers with relevant skills and proper nutrition training (133).

Nutrition training and counseling has also been successfully applied using specially selected and trained peer groups working hand-in-hand with trained health workers. For example, in a study conducted in Senegal, trained community health workers trained grandmothers, who in turn provided maternal and child health education on topics including child feeding to mothers and pregnant women (139). Community and home-based interventions conducted by trained peers in collaboration with trained health workers have had success in areas with limited resources (133, 140, 141). Pictures, posters, school rallies, street-side plays, and nutrition fairs have been commonly used to provide such forms of training or counseling. These illustrations can be ever more effective when tailored to the regional context (126).

Nutrition training for health workers has yielded varied impacts on child health, particularly regarding nutrition status. Previous systematic reviews have evaluated the impacts of nutrition counseling, maternal nutrition education (56), and complementary feeding on children's nutrition status (57, 58). However, no systematic review has been conducted to evaluate the effectiveness of nutrition training for health workers on child feeding practices, an important step to improving their nutrition status. Therefore, I conducted this systematic review to examine the effect of nutrition training for health workers on feeding frequency, energy intake, and dietary diversity of children between six months and two years of age. The PICO (Population, Intervention, Comparator, Outcome) question was as follows: "What is the effect of nutrition training for health workers to improve caregivers' feeding practices including energy intake, feeding frequency, and dietary diversity of children under two years of age as compared to those who did not receive such training?"

3.2 Methods

3.2.1 PICO items

In this systematic review, I included RCTs and cluster RCTs that incorporated nutrition training for health workers as an intervention of interest. I defined nutrition training for health workers as any formal nutrition course provided to health workers in the form of in-service training, continuing professional education, short courses, or seminars, aimed for practical or research purposes at improving the nutrition knowledge or practices of health workers. I defined the population as health workers including doctors; nurses and nurse midwives; midlevel providers including assistant medical officers, clinical officers, assistant nurses, or assistant physicians; community health workers including village health workers; and nutritionists or dietitians working in the areas where the studies were conducted. I focused the attention on three outcome variables: feeding frequency measured in the number of times the child was fed in the previous 24 hours; energy intake in kilojoules (kJ) per day; and dietary diversity, defined as the variety of food items that was fed to a child.

I developed a review protocol based on the aforementioned guidelines that was shared among the researchers before conducting the literature search. This protocol provided guidance regarding the literature search, exclusion and inclusion criteria, methods of analysis, and grading of evidence. Based on this framework, three researchers independently conducted literature searches, selection of studies, and data extraction.

3.2.2 Data sources for existing review

Three researchers including myself independently searched the medical databases based on the review protocol. First, I searched for any existing review or submitted protocol on the topic listed in the Cochrane Library or the Cochrane Database of Systematic Reviews (CDSR). I also searched for similar review articles in the Database of Abstracts of Reviews of Effects (DARE), National Institute for Health and Clinical Excellence (NICE), Educational Resources and Information Center (ERIC), and Campbell library of systematic reviews databases.

3.2.3 Inclusion and exclusion criteria

I included RCTs and cluster RCTs that included an explanation of nutrition training provided to health workers and child feeding practices such as dietary diversity, feeding frequency, and energy intake. I also included studies that provided information and counseling on feeding practices to caregivers of children aged six months to two years.

I excluded studies that had recruited children aged below six months and above two years. The age range of 6 months to 2 years was chosen as the focus for this study because of its importance as the transitional period from exclusive breastfeeding to complementary feeding and family foods. Studies have shown a rapid increase in rates of undernutrition during this stage (142). Such increases in developing countries may largely be associated with inappropriate feeding practices. Also, due to wide variations in the daily required nutritional and energy intake with age, it is difficult to generalize feeding practices for children below and above two years of age. I also excluded results covering feeding practices among children on exclusive breast-feeding regimens; on special feeding interventions including parenteral feeding and tube feeding; or subject to special feeding requirements or diagnosed with chronic conditions.

3.2.4 Search strategy

I conducted the literature search using medical databases including PubMed/MEDLINE, CINAHL, EMBASE, and ISI Web of Knowledge, as well as within WHO regional databases. I limited the search to a 15-year publication window (November 1st 1997 to October 30th 2012). For the PubMed databases I used the search details shown in **Additional file 1**. Using the Boolean combination shown in this file, I retrieved a total of 2074 articles. I used similar text words for other databases according to the database's set-up. I also conducted hand searching using the reference lists of identified articles of interest. **Figure 4** shows the flow chart of the studies thus identified and the screening process for inclusion. This figure is a modified version of the PRISMA checklist (92).

Figure 3: Flow diagram of the phases of systematic review 2

Identification

Records identified through PubMed/MEDLINE database searching (n = 2,074)

Additional records identified through other databases and hand search sources (n = 2683)

Total records agreed upon by the three researchers (n = 4,757)

Screening

Available records after exclusion of 2051 duplicates (n=2,706)

Irrelevant to the research question (n = 2630)

Eligibility

Full-text articles assessed for eligibility (n = 76)

Full-text articles excluded as ineligible (n = 66)
- Different outcome (n = 28)
- Unclear or no nutrition training for health personnel (n = 17)
- Unclear or lack of information on health personnel cadre (n = 9)
- Population with special needs of chronic ailments (n = 12)

Records available for the whole study n = 10

Included

Studies included in quantitative synthesis (meta-analysis) n = 8

I retrieved a total of 4757 articles. Of these, 2074 articles were from PubMed and 2683 from other medical databases or retrieved through hand searches of the reference lists of initially selected articles. I compared the search results of the three independent researchers and reached agreement on the final figures. On initial screening, a total of 2051 duplicate articles were excluded because they appeared in both PubMed and other databases. Furthermore, I excluded a total of 2630 articles on initial screening which did not fit the focus of the study. I then conducted a full screening on the remaining 76 articles, out of which 66 articles were further excluded for various reasons: 17 lacked information on nutrition training of health workers, 28 had no clearly defined outcome variable matching the criteria, 9 had health personnel that did not fit the criteria of health personnel, and 12 had a population with a chronic condition or special needs (**Figure 4**).

3.2.5 Grading of evidence and risk of bias

I evaluated the quality of the selected studies using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) technique (143, 144). GRADE quality assessment is used to evaluate studies individually, and provides an overall assessment of the pooled evidence. The quality of evidence can be categorized as "high", "moderate", "low", or "very low" based on the study design, strengths and limitations, population size, and effect size of the pooled results. Using this method, I also examined the risk of bias inherent in the individual studies included. This was also done at the outcome level.

In this study, I evaluated the quality of the evidence on energy intake and feeding frequency, arriving ultimately at a "high" quality grade (**Table 8**).

Table 8: Quality assessment of studies included in the systematic review

Number of studies	Design	Limitations	Inconsistency	Indirectness	Imprecision	Other consideration	Effect sizes (95% CI)	Quality
				Quality assessment			**Summary of findings**	
				Energy intake per day				
5	RCT and cluster RCT	No serious limitation	Three studies presented data in Mean (SD) and two in Median (IQR)	No serious indirectness	No serious imprecision	Strong association, no serious publication bias	Mean: Pooled SMD: 0.76 (0.63-0.88) Median: Pooled SMD: 1.06 (0.87-1.24)	High
				Feeding frequency per day				
5	RCT and Cluster RCT	No serious limitation	Three studies had Means (SD) and two had % of feeding frequency >3/day	No serious indirectness	No serious imprecision	Studies showed strong association.	Mean: Pooled SMD: 0.48 (0.38-0.58) Frequency: Pooled RR: 0.99 (0.87-1.13)	High

I also conducted a risk of bias (RoB) analysis (**Table 9**). Based on the Cochrane Handbook for Systematic Reviews of Interventions (145), five types of bias were evaluated at the study level. These were selection bias, performance bias, detection bias, attrition bias, and reporting bias. There was a serious risk of bias in two of the ten selected studies (146, 147).

In Bhandari's study in 2001 (146), no information on allocation concealment was available. Also, authors did not indicate whether the control group received any intervention or care, which might have introduced a performance bias. In a 2005 study by Kilaru and others. (147), meanwhile, I could not find information on allocation concealment, performance bias, or attrition bias. However, this study indicated a low risk of reporting and detection biases. Despite the indicated RoB, results of these studies are not different from the rest of included studies. I therefore determined that the said risks of bias are unlikely to have markedly influenced the overall outcome of the review.

Table 9: Risk of bias assessment

Bhandari N 2001 (146)	Santos I 2001 (76)	Bhandari N 2004 (148)	Penny ME 2005 (83)	Zaman S 2008 (59)	Shi L 2010 (149)	Roy SK 2005 (136)	Vazir S 2013 (60)	Pachon H 2002 (61)	Kilaru A 2005 (147)	Bias
?	+	+	+	+	+	+	+	+	−	Selection bias: Allocation concealment
−	+	+	?	+	+	+	+	+	?	Performance bias: Blinding of participants and personnel
+	+	+	+	+	+	+	+	+	+	Detection bias: Blinding of outcome assessment
+	+	+	+	+	+	?	+	+	?	Attrition bias: Incomplete outcome data
+	+	+	+	+	+	+	+	+	+	Reporting bias: Selective reporting

+ : Low risk of bias　− − : High risk of bias　? : Unclear or undetermined risk of bias

3.2.6 Data synthesis and meta-analysis

Outcome variables of interest in this study were energy intake, feeding frequency, and dietary diversity, all measured for the previous 24 hours. For energy intake, three studies presented the mean values and standard deviations (61, 76, 148), while two other studies presented their data in the form of median values and interquartile ranges (60, 146). Because of such diversity in the reported results, I conducted a separate meta-analysis of these studies. For consistency, I converted energy intakes in kilocalories (kcal) to kJ per day in three studies (60, 61, 83). For feeding frequency, three studies presented their data as the mean feeding frequency per day (61, 148, 149), while two studies presented their data as percentage of participants with daily feeding frequencies higher than three (136, 147). I also conducted a separate meta-analysis due to such inconsistency in the reported results.

Several studies were excluded from meta-analyses due to missing or incompatible data. I did not include a study by Penny et al. (83) in meta-analyses because it lacked data on standard deviations for mean energy intake. Also, this study presented results of energy intake from animal sources only; other studies provided data on total energy intake from all complimentary foods consumed in a day. I could not conduct meta-analyses for the seven studies reporting results for the dietary diversity outcome (59, 60, 76, 83, 147-149) due to differences in the categorization used in each study and the diversity of foods available in the respective study areas.

I used the *metan* command for STATA version 12 (StataCorp, College Station, Texas, USA) to calculate the effect size in the form of standardized mean differences (SMDs) and risk ratios; to calculate their 95% CIs; to assess the statistical heterogeneity among trials; and to construct the forest plots. For the dietary diversity outcome, I compared the frequencies and percentages of foods consumed between the intervention and control group in each RCT. Though the types of foods varied across studies, they were comparable within each trial. Chi-square tests were used to compare food type consumed in intervention and control groups in the three studies.

For each study selected for analysis, I chose the comparable results reported within similar age groups for intervention and control groups to reduce the effect of heterogeneity. Some of the studies that fit the inclusion criteria also presented results of age groups beyond the set criteria. Also, some studies presented results within the age groups of interest, but followed them up for the duration of the intervention and hence presented multiple results for the same subjects. However, I selected comparable results only for children aged between 6 and 18 months. I calculated SMDs for control and intervention group within similar age groups and pooled them to calculate effect sizes for energy intake and feeding frequency. For the data presented on follow-up results, I took the results at the end of the intervention.

3.3 Results

3.3.1 Study selection

Out of 4757 identified studies, 10 studies (59-61, 76, 83, 136, 146-149) were included in the final analysis. Among these studies, 5 studies (60, 61, 76, 146, 148) had enough data for meta-analysis of energy intake and 5 studies (61, 136, 147-149) for meta-analysis of feeding frequency. None of the RCTs had suitable data for meta-analysis on dietary diversity; I therefore included 7 studies with descriptive dietary diversity data (59, 76, 83, 147-149) for descriptive-only analysis of dietary diversity (**Table 10**).

Table 10: Description of studies included

Author	Country	Design	Population	Intervention	Comparator	Results- outcome of interest		
						Feeding frequency	**Energy intake**	**Dietary diversity**
Bhandari N 2001 (146)	India	RCT	Nutritionists, Caregivers and their children. (Intervention-n=104, Control 106)	Intervention group received nutrition training from the trained nutritionists. Description of training duration for nutritionists was not provided.	Comparison group's health workers were not trained to provide n=106	No details	At 9 months • I: 978kj/day; IQR 406-1371 • C: 577kj/day; IQR 196-1250 • P<0.05 At 12 months • I: 1417kj/day; IQR 723-2253 • C: 924kj/day; IQR 474-1471 • P<0.05	No details
Santos I 2001 (76)	Brazil	Cluster RCT	Doctors (Intervention-17, Control-16) and pairs of caregivers and their children (Intervention-218, Control-206)	Nutrition counseling component of WHO's Integrated Management of Childhood Illness (IMCI) given for 20 hours to doctors in the intervention group. The trained doctors provided counseling to caregivers.	16 doctors did not receive nutrition counseling training. They offered general care to caregivers and their children	No details	At <18months • Intervention: 3827.5kJ/day; SD 1230.9 • Control: 3546.8kJ/day; SD 1058.1 • P=0.3	Compared to Control, Intervention group had higher proportion of dietary diversity
Bhandari N 2004 (148)	India	Cluster RCT	Health and nutrition workers; pairs of caregivers	Health and nutrition workers in the 4 intervention communities received	Health and nutrition workers in 4 communities without nutrition	At 9 months: • I: 4.4; SD 1.5 • C: 3.9; SD 1.7	At 9 months: • I: 1556kJ/Day; SD 1109 • C: 1025kJ/Day; SD 866	Compared to Control, Intervention group had

			and their children	nutrition training. They cared for 552 child-mother pairs.	training. They cared for 473 child-mother pairs.	At 18 months • I: 5.9; SD 1.2 • C: 5.4; SD 1.3	• P<0.01 At 18 months • I: 3807kJ/Day; SD 1527 • C: 2577kJ/Day; SD 1058 • P<0.01	high proportion of dietary diversity
Penny ME 2005 (83)	Peru	Cluster RCT	Health care workers and pairs of caregivers and their children	Health care workers in 6 health facilities received nutrition-training intervention; 187 babies were enrolled and their caregivers were counseled by these health workers.	Health care workers in 6 health facilities without the nutrition training intervention. They gave care to 190 babies enrolled in these facilities.	No details	At 9 months: • I: 450kcal/day • C: 400kcal/day At 18 months • I: 960kcal/day • C: 800kcal/day • P=0.001	Dietary diversity at 18 months was higher in intervention group than the control group
Zaman S 2008 (59)	Pakistan	Cluster RCT	Community Health Workers and pairs of caregivers and their children	Health workers in 18 health centers received a 5 half days nutrition training using the WHO's IMCI training module for nutrition. They recruited and gave counseling and consultation to151 child-mother pairs	Health workers in other 18 health centers without nutrition training intervention recruited and cared for 169 pairs of mothers and children	No details	No details	Intervention group had a higher proportion on all the food items consumption compared to the control group
Shi L 2010 (149)	China	Cluster RCT	Primary healthcare providers; pairs of mothers and	Health care providers received nutrition training on complementary feeding, breastfeeding, and counseling skills. They	Health workers from township hospitals did not receive nutrition training. Recruited and cared for 305	At 9 months • I: 3.77; SD 1.62 • C: 2.53; SD1.82 • P<0.001 At 12 months	No details	Intervention group had a higher proportion on all the food items

			infants	counseled and provided care for 294 pairs of caregivers and their children.	pairs of caregivers and their children.	• 4.17 • I: 2.90; SD 1.85 • P<0.001		consumed compared to the control group
Vazir S 2013 (60)	India	Cluster RCT	Community health workers (Village health workers) n=60 and 511 pairs of mothers and their children	Village health workers received supervised training on how to counsel mothers/caregivers on complementary feeding, and responsive feeding. Caregivers who received such counseling also received standard care.	Village health workers did not receive training. They provided only standard of care to caregivers and their children.	No details	At 9 months • I: 348 kcal/day; IQR 229,540 • C: 209 kcal/day; IQR 122,338 • P<0.005 At 15 months • I: 569 kcal/day; IQR 539,618 • C: 460; IQR 429,489 • P<0.005	Intervention groups (complementary and responsive feeding groups) had a higher proportion on all the food items consumption compared to the control group
Roy SK 2005 (136)	Bangladesh	RCT	Nutritionists, medical officer, and health assistants	Two-week nutrition training was conducted for health workers. The training included nutrition education, counseling, and anthropometry. Trained health workers provided counseling to mothers of moderately malnourished children on complementary feeding.	Mothers of a control group received normal care from health workers who received no nutrition training	Feeding frequency >3 times/day At 3 months I: 98%, C: 54% At 6 months I: 97%, C: 58%	No details	No details

| Pachon H 2002 (61) | Vietnam | Cluster RCT | Community health workers and 240 pairs of caregivers and their children | Training implementers (health workers) who are also health volunteers received nutrition training to implement intensive nutrition rehabilitation sessions for ten months. Counseling for caregivers was done twice a week for nine months. | Health workers were not trained to implement intensive nutrition rehabilitation sessions. | At 2-6 months
• I: 4.6; SD 1.3
• C: 4.2; SD 1.1
• P<0.01
At 12 months
• I: 4.9; SD 1.5
• C: 4.4; SD 1.5
• P<0.01 | At 2-6 months
• I: 662.7kcal/day; SD 301.0
• C: 597.4kcal/day; SD 275.7
• P<0.1
At 12 months
• I: 826.9kcal/day SD 324.4
• C: 718.4kcal/day SD 330.0)
• P<0.01 | No details |
| Kilaru A 2005 (147) | India | Cluster RCT | Auxiliary nurse midwives, community health workers | Auxiliary nurse midwives, community health workers received nutrition training from MCH consultant (pediatrician and nutritionists). They provided counseling to 173 caregivers and their children | Normal standard of care provided by auxiliary nurse midwives who did not receive any special nutrition training | At 7-11months Feeding frequency >4 times/day
• I: 78%
• C: 51%
• P<0.001 | No details | At 11months Feeding at least 5 types/day
• I: 42%
• C: 19%
• P=0.01 |

Footnotes
I- Intervention group, C- Control group, P- P value, SD- Standard deviation, IQR- Inter quartile range, CI- Confidence Interval

3.3.2 Energy intake per day for children aged six months to two years

The pooled evidence from the three trials reporting on mean energy intake (**Table 11**) showed that, nutrition training of health workers improved daily energy intake of children aged six months to two years. The pooled SMD between the intervention and control groups was 0.76 with a 95%CI of 0.63 to 0.88 in a random model. The test for overall effect gave z = 12.17, P<0.001. For the two studies with median energy intake presented with interquartile ranges (**Table 11**), the pooled SMD was 1.06, with a 95% CI of 0.87 to 1.24. The test for overall effect gave z=11.22, P<0.001.

Table 11: Effectiveness of the intervention on energy intake per day

Mean energy intake (kJ/day)

Study, year	SMD	95% CI	% Weight	Forest plot
Bhandari N, 2004 (148)	0.93	0.78-1.07	72.07	
Santos I, 2001 (76)	0.24	-0.24-0.73	6.32	
Pachon H, 2002 (76)	0.33	0.07-0.59	21.61	
I-V Pooled SMD	0.76	0.63-0.88		
Heterogeneity chi-square = 19.91 (d.f. = 2) p < 0.001 Test of SMD=0; z=12.17 p < 0.001				

Median energy intake (kJ/day)

Study, year	SMD	95% CI	% Weight	Forest plot
Bhandari N, 2001 (146)	0.38	0.10-0.67	42.45	
Vazir S, 2013 (60)	1.55	1.31-1.80	57.55	
I-V pooled SMD	1.06	0.87-1.24		
Heterogeneity chi-squared = 37.63 (d.f. = 1) p <0.001 Test of SMD=0: z= 11.22 p < 0.001				

3.3.3 Feeding frequency for children aged six months to two years

The pooled evidence from the three trials reporting on mean feeding frequency (**Table 12**) showed that: nutrition training of health workers improved the mean feeding frequency of children under two years of age. The SMD between the intervention and control groups was 0.48, with a 95% CI of 0.38 to 0.58 in a random model. The test for overall effect gave z = 9.17, P<0.001. For the two studies with feeding frequency as a percentage (**Table 12**) showed pooled risk ratio (RR) of 0.99, 95% CI (0.87-1.13). The test for overall effect, z=0.09, P=0.926.

Table 12: Effectiveness of intervention on feeding frequency per day

Mean feeding frequency per day

Study, year	SMD	95% CI	% Weight	Forest plot
Bhandari N, 2004 (148)	0.40	0.26-0.54	55.94	0.40 (0.26,0.54)
Shi L, 2009 (149)	0.72	0.53-0.91	28.82	0.72 (0.53,0.91)
Pachon H, 2002 (76)	0.33	0.07-0.60	15.24	0.33 (0.07,0.60)
I-V Pooled SMD	0.48	0.38-0.58		0.48 (0.38,0.58)
Heterogeneity chi-squared = 8.42 (d.f. = 2) p = 0.015 Test of SMD=0: z= 9.17 p <0.001				

Feeding frequency >3 times per day

Study, year	RR	95% CI	% Weight	Forest plot
Roy SK, 2005 (136)	0.80	0.66-0.98	52.01	0.80 (0.66,0.98)
Kilaru A, 2005 (147)	1.20	1.01-1.43	47.99	1.20 (1.01,1.43)
M-H pooled RR	0.99	0.87-1.13		0.99 (0.87,1.13)
Heterogeneity chi-squared = 8.93 (d.f. = 1), p = 0.003 Test of RR=1: z= 0.09, p = 0.926				

3.3.4 Dietary diversity for children aged six months to two years

In the RCT conducted in Brazil (76), health workers who received nutrition training provided counseling to caregivers. Children whose caregivers were counseled by trained health workers had a higher dietary diversity compared to their counterparts (P<0.001). Similar interventions were conducted in India (60, 147, 148). In these three trials, too, children in intervention groups had significantly higher dietary diversities compared to their counterparts in control groups. Other RCTs conducted in Pakistan (59), Peru (83), and China (149) showed similar results: higher percentages of children in intervention group consuming each type of food items compared to their counterparts in the control group (**Table 13**).

Table 13: Effectiveness of the intervention on the dietary diversity

Author, Year	Outcome	Intervention	Control	P-value
Santos I, 2001 (76)	Dietary diversity at 18 months	N = 206	N = 216	P-value
	Egg yolk	19.20%	8.20%	P<0.01
	Shredded chicken and beef	15.50%	6.30%	P<0.01
	Chicken liver	20.50%	6.80%	P<0.001
	Oil, margarine or butter	16.90%	0.50%	P<0.001
Bhandari N, 2004 (148)	Dietary diversity at 18 months	N = 435	N = 394	
	Cereal legume gruel or mix	49.6%	31.7%	P<0.001
	Milk cereal gruels or mix	133.3%	14.9%	P<0.001
	Undiluted milk	60.5%	12.9%	P<0.001
	Added oil/butter	24.1%	5.8%	P<0.001
	Snacks	58.2%	54.1%	
	Commercial bread	23.0%	10.7%	P<0.001
	Home-made bread	82.1%	86.3%	
	Rice	8.3%	7.6%	
	Potatoes	29.0%	22.1%	P<0.001
	Legumes	29.7%	23.9%	P<0.01
	Milk	98.6%	95.9%	
	Vegetables	26.0%	24.1%	
	Fruits	144.8%	40.4%	
Penny ME, 2005 (83)	Dietary diversity at18 months	N = 171	N = 167	
	Egg, chicken liver or fish	64.0%	57.0%	
Zaman S, 2008 (59)	Dietary diversity at 18 months	N = 126	N = 131	
	Eggs	47.6%	26.7%	
	Chicken/beef/mutton	60.3%	39.7%	
	Liver	30.9%	19.9%	
	Added ghee/butter/oil	53.9%	38.2%	
	Thick kitchuri	65.9%	44.3%	
Shi L, 2010 (149)	Dietary diversity at 12 months	N = 256	N = 234	
	Bread, rice, noodles	100 %	98.3%	
	Roots or tubers	90.9%	73.8%	
	Yellow/orange foods	97.2%	76.7%	
	Green leafy vegetables	97.6%	87.9%	
	Beans/peas/lentils	92.1%	67.2%	
	Fruits	99.6%	96.6%	
	Eggs	98.8%	92.2%	
	Meat or organ meats	96.9%	58.2%	
	Cooking oils/fats	96.5%	79.7%	
Kilaru G, 2005 (147)	Dietary diversity at 11 months	N = 173	N = 69	
	At least 5 different groups	42.0%	19.0%	P = 0.01
Vazir S, 2013 (60)	Dietary diversity at 15 months	N = 170	N = 168	
	Rice	99.5%	94.9%	
	Goat/chicken liver	38.0%	13.1%	
	Goat meat	43.5%	33.0%	
	Poultry	37.5%	18.9%	
	Banana	79.3%	61.9%	
	Buffalo milk	81.5%	72.7%	
	Egg	73.9%	54.0%	
	Spinach	42.4%	29.5%	
	Pulses	89.7%	71.6%	
	Added fat	42.4%	29.5%	

3.4 Discussion

This is the first systematic review to evaluate the effectiveness of nutrition training of health workers on children feeding practices. Previous reviews showed the effectiveness of maternal nutrition education and complimentary feeding interventions to improve child feeding practices (57) and nutrition status (56, 58). This study helps to show a possible pathway to improve child nutrition status by starting with health worker training. I found that training of health workers can help to improve feeding practices of children between six months and two years of age. The children whose caregivers were counseled by the trained health workers had a higher mean feeding frequency, energy intake, and dietary diversity compared to their counterparts.

Strong evidence thus suggests that nutrition training of health workers improves energy intake, feeding frequency, and dietary diversity of children between six months and two years of age. Such a significant outcome may be conceived through the following pathway: First, nutrition training can increase or refresh health workers' nutrition and food sciences-related knowledge. Indeed, two RCTs conducted in Brazil (80) and India (146) found that nutrition training of health workers improved their knowledge in nutrition. Nutrition training can be used to update health workers' nutrition knowledge and to alert them to new findings pertinent to their environments (53, 59, 125, 134). This will enable them to address determinants of undernutrition specific to their areas, and to improve their communication, counseling, and undernutrition management skills (59, 76, 80, 83, 148). Updated management skills including tailored counseling may also be important for the effective transfer of knowledge to the end users – in this case, the caregivers.

Second, nutrition knowledge transfer by skilled and trained health workers may be achieved when they counsel caregivers who visit health facilities (126). Similarly, trained health workers may also access caregivers through outreach and home visits even in rural areas, and may achieve a similar outcome through such routes (147, 150). Previous RCTs showed improved nutrition knowledge and knowledge retention among caregivers counseled by health workers who received nutrition training (59, 76, 83, 125, 136, 150).

Third, the counseled caregivers can serve as agents of change. Caregivers endowed with updated nutrition knowledge through frequent counseling can improve their own child feeding behaviors (59, 76, 83, 125, 126, 134, 136, 147-149, 151). Such behaviors may include food preparation hygiene, feeding frequency, proper mixing of quality foods, increased energy intake, and dietary diversity. Thus, children's growth can improve and their risk of undernutrition can be minimized (56). Secondarily, other determinants of undernutrition such as food-borne infections can be reduced (83, 152, 153) and food preparation hygiene improved (149).

Nutrition counseling from trained health workers has been proven effective even in areas of limited food availability (56, 136). In such circumstances, caregivers were able to choose the right mix of foods under availability constraints. For example, in the RCT conducted in Bangladesh, about a third of families were poor and lived in food-insecure households. Despite such hardship, nutrition knowledge gained from trained health workers motivated and changed their feeding behavior. Thus, they could provide the required balance of foods to their children using the available resources (136).

The findings of this review should be interpreted in light of several limitations. First, the selected studies came from different regions and there is a risk of regional variations. Such regional variations can cause differences in characteristics of participants as shown in Table 10. Also, the selected studies were conducted in the context of different health systems. In this case, the nutrition training was conducted to the health workers of different carders. For example, in Bangladeshi and India studies, training was conducted among nutritionists and other health carders including medical officers. In other settings, training was conducted among health carders available in such settings, including doctors, primary health care providers, auxiliary nurses, midwives, health assistants, and community health workers as shown in Table 10. To minimize this limitation, I selected RCTs and cluster RCTs as these studies can minimize the effect that could have been caused by differences in intervention and control groups. Meta-analysis pools the SMDs of each study into a single effective size. This can help to reduce any discrepancies arising from variations across studies.

Second, I could not conduct a meta-analysis for the dietary diversity outcome. This was due to the differences in types of foods reported in the trials included in this study. Such differences were also due to regional variations in the typical diet. Also, in all the selected studies, dietary diversity was not a primary outcome. Lack of a standard method for data collection on dietary diversity might also be a reason for such differences. To minimize the effect of variations in food type, regional, and methodological aspects, I compared the results of diets consumed within the trials. All the seven trials showed better dietary diversity for the intervention compared to the control groups. Therefore, despite the regional and methodological differences in reporting dietary diversity, all studies showed the effectiveness of the intervention on dietary diversity among children under two years of age.

Third, our results showed a significant heterogeneity among the selected studies. This might manifest in differences in training duration and qualifications of health workers, in targeted age groups, in follow-up procedures, and in regional context. I could not retrieve the training duration for all of the selected trials. However, some of the selected trials used a standardized Integrated Management of Childhood Illness (IMCI) training manual developed by WHO, while others used results of formative research conducted prior to the trial. Moreover, results from all the selected studies were consistent. Although these studies were conducted in different regional contexts, they all showed a significant improvement in feeding practices when health workers received nutrition training.

Fourth, due to time limitations, I did not register a study protocol prior to the review process. To minimize such limitations, I developed the in-house review protocol based on the pre-set guidelines before starting the evidence search. The protocol was shared among the research team and the three independent researchers who conducted the evidence search. I evaluated each step of data collection as a team to verify the scrupulous use of the protocol. To this end, I was satisfied that the original protocol was adhered to.

Fifth, my results may also not be generalizable beyond the low- and middle-income countries where the selected studies were conducted. However, based on the global nutrition situation, these are the

areas with the highest burden of child undernutrition. These results may thus be especially useful to scale up the nutrition training of health workers toward improving the current child undernutrition situation.

Despite its limitations, this study also has notable strengths. This is the first systematic review to examine the effectiveness of nutrition training of health workers on child feeding practices. Second, I used the GRADE method to critically assess the quality and strength of the evidence presented. Overall, the evidence of intervention effectiveness on feeding frequency and energy intake was of high quality. Thus, the results of this systematic review may help to design policies to improve feeding practices of children through training of available health workforce cadres.

In conclusion, nutrition training for health workers can improve feeding practices for children under two years of age. Such practices include feeding frequency, energy intake, and dietary diversity. Training materials should be prepared based on the local context and should include information on how to identify foods that are available, affordable and acceptable, which is particularly important in areas of limited food availability. Moreover, trained health workers offer the prospect of an accessible and reliable information resource for local families. In this way, nutrition training for health workers can serve as an important entry point for a sustainable strategy toward improving the nutrition status of young children.

Chapter 4:

Poor nutrition status and associated feeding practices among HIV-positive children in a food secure region in Tanzania: a call for tailored nutrition training

4.1 Background

Poor feeding practices undermine efforts to combat unacceptably high rates of undernutrition among children in developing countries (8, 154). Such practices include low feeding frequency, low dietary diversity, inadequate quantity, and diets with poor quality (50, 154). Efforts to improve feeding practices can also improve undernutrition among children in developing countries (55-57, 149).

Poverty and other socio-demographic disadvantages can limit adequate feeding practices (155, 156). Households in low economic strata are prone to food insecurity (23, 157, 158). Under such circumstance, poor households have limited choices for food with adequate nutritional values (157, 158). They usually adapt themselves to this situation by cutting down the number of basic meals or reducing the amount in each meal (159, 160). In a typical household affected by food insecurity, children are usually less afflicted during its early stage. At this stage, other members of the household tend to reduce amount and frequency of food for themselves for the sake of their children. However, children have higher risk of being affected by extreme forms of food insecurity and later, hunger. Socio-economic disadvantages and the cycle of poverty are also associated with poor education. Children of poorly educated caregivers succumb to various forms of undernutrition (3). The possible link could be through poor feeding practices (161).

Through high agricultural yield or high purchasing power, food availability can reduce a household's food insecurity (162). However, even when sufficient food is available, its consumption may not be adequate. This is because the consumption of diverse types of foods in adequate quality, quantity, and frequency may depend on nutrition knowledge of caregivers (50, 163). This may also be a reason behind the high rates of undernutrition among children in the general populations of many developing countries, including Tanzania, even where food productivity is relatively high (164, 165).

In developing countries, if children are affected by HIV in a household, such household is more likely to have lower potential to provide them with food of adequate quality, quantity, and in the required frequency compared to households of HIV-negative children (3, 7, 160, 161). Furthermore, HIV-

positive children have special nutritional needs, different from their HIV-negative counterparts (41).

The World Health Organization (WHO) recommends a 10% increase in energy intake for the HIV-positive child growing well on antiretroviral therapy (ART) above the normal requirement of an otherwise HIV-negative child of the same age (41). A 20-30% increase in energy intake is required to sustain an HIV-positive child with HIV-related symptoms including TB, chronic lung infections, or persistent diarrhea (41). HIV-positive children need an extra 50-100% of energy intake compared to an otherwise normal child if they have severe malnutrition or severe failure to thrive, regardless of their ART status (41). These energy requirements are supposed to be met from the foods consumed daily. To achieve adequate nutrition, an HIV-positive child is supposed to eat at least five times a day (41). Such meals have to be balanced, diverse, and adequate in amount.

Food insecurity and poor feeding practices can also affect the effectiveness of ART and drive the HIV-positive children further into undernutrition. Appropriate use of ART should reduce the risk of a child succumbing to opportunistic infections that can affect his/her nutrition status (15, 16, 26). However, its use comes with its own risks especially in the context of food insecurity and hunger (166). Food insecurity is known to intensify ART's side effects to the extent of intolerability (7). To avoid symptoms of ART's side effects, caregivers in some areas give their children ART when they are sure of accessing food to accompany it (5). This results in poor adherence and sometimes pushing the children further into advanced stages of HIV and undernutrition (7, 166). In Tanzania, too, households with HIV-positive children had a lower dietary diversity score, feeding frequency, and a higher proportion of food insecurity compared to households with HIV-negative children (167).

To decrease undernutrition among HIV-positive children in Tanzania and in other similar areas, feeding practices should be improved (167). However, to provide culturally appropriate interventions, it is important to understand the local determinants of poor feeding practices among such children. So far, little has been examined about the determinants of poor feeding practices among HIV-positive children in areas where food production is high. In this study, I therefore first examined the magnitude of undernutrition and poor feeding practices. Next, I examined local determinants of undernutrition

including its association with feeding practices. Third, I examined the local factors associated with

poor feeding practices, in particular, low feeding frequency, among children living with HIV in Tanga,

Tanzania. Finally, I further explored the key associations by conducting a qualitative inquiry.

4.2 Methods

4.2.1 Study design and area

I employed a mixed method design for this study. First, I conducted a cross-sectional quantitative study to examine the magnitude and determinants of undernutrition and poor feeding practices among HIV-positive children in Tanga, Tanzania. Results of this study guided a qualitative study. Through seven focus group discussions (FGDs), I explored possible explanations of the findings and the key associations between various determinants and undernutrition among HIV-positive children. Finally, I triangulated results from both methods to help explain the causal relations of the associations between feeding practices and nutrition statuses among HIV-positive children in this food rich region. This study seeks to contribute to the operational research (65), aiming to improve feeding practices and thus nutritional status of such vulnerable children.

In the Tanga region, a vast diversity of food is available and grown. It is the leading region in fruit and vegetable production in the country and supplies other regions with cereal, fruits, marine, and diary products. The presence of such quantity and diversity of foods is not correlated with consumption and nutrition status. Only 59.4% of 292 sampled under-five children in Tanga consumed foods rich in Vitamin A (164). Tanga has the worst nutrition outcomes in the country despite the foods available. For example, stunting prevalence was the highest in the country with about 49% of 315 under-five sampled children, 12% had underweight, and 5.5% had wasting. Poor feeding practices could also be behind poor micronutrient markers among children. In the same population, 38.9% of children had Vitamin A deficiency, 36.5% had iron deficiency, and 52.2% had iron deficiency anemia (164).

A total of 20,773 people living with HIV were enrolled in care and treatment centers (CTCs) in the Tanga region in 2009. Although the prevalence of HIV among children has not been reported for Tanga, about 1,800 HIV-positive children were enrolled in the CTCs for care and treatment. The current study was a hospital-based study and conducted among participants who were attending CTCs in the region. I described the CTCs' organization and distribution in a separate article (65)

After obtaining confirmatory test results using the standard algorithm (168), HIV-positive children are usually enrolled in the CTCs to receive care. Such care includes treatment with ART, follow up, adherence counseling, and treatment of other associated opportunistic infections (168). They are also supposed to receive nutrition care and monitoring. However, during this study period, no specific nutrition intervention was carried out targeting HIV-positive children attending these CTCs. Health workers attending these children also were not equipped with any inservice nutrition training to improve their management skills, and the new WHO *Guidelines for an integrated approach to the nutritional care of HIV-infected children (6 months – 14 years)* (41) had not yet been locally adapted.

4.2.2 Participants

I recruited pairs of HIV-positive children and their caregivers who were attending the CTCs for their children to receive care and/or treatment. Inclusion criteria were children aged between six months and fourteen years, who are registered at or have been transferred to the CTC, who have ART records, and whose caregiver gave consent to participate in the study. I excluded children with missing medical records.

I selected a convenience sample of nine out of 32 CTCs that give care to such patients. The selected health facilities represented most districts of the Tanga region and have at least 20 children registered. Out of 32 CTCs, 15 fulfilled this criterion. I selected the CTC with the highest number of children if the district had two or more CTCs with at least 20 children. Because of its size and high number of patients, I selected three CTCs from the Tanga municipality. This process resulted in a final selection of nine CTCs for this study which, according to medical records, had a total of 1,248 children registered.

I recruited a total of 797 pairs of children and their caregivers for this study, who attended the clinic on the day of data collection, and fulfilled the criteria. I excluded the data of 49 children after data collection. Among them, 41 had missing variables or erroneous entries for the outcome variable, and

eight had not met the selection criteria. Therefore, data were available for analyses from 748 pairs of HIV-positive children and their caregivers who were attending CTCs.

I also conducted seven FGD sessions with the caregivers of HIV-positive children attending CTCs in Tanga region. The initial plan was to conduct nine focus group discussions; one from each CTC selected for the quantitative survey. However, I had reached the saturation point at the seventh group and no new information was emerging. I conducted each FGD in a separate district to reach participants in different geographic areas within the region. I conveniently selected participants who agreed to participate and who had time for the discussions when they were done with care and treatment or an ART refill for their HIV-positive children. I invited eight participants for each group, for a total of 56 caregivers.

4.2.3 Measurements

Nutrition status: The outcome variables of interest were measures of nutrition status including stunting, underweight, thinness, and wasting. A low height for age, below or equal to -2 SD of the reference population, signifies moderate stunting while below or equal to -3 SD signifies severe stunting (169-171). To measure height, I used a standard measuring board calibrated in centimeters and converted it to height-for-age z-scores (HAZ).

Wasting is measured by weight for height of children aged 6-60 months (up to five years of age). A low weight for height/length, below or equal to -2 SD of the reference population, signifies acute moderate wasting, while below or equal to -3 SD signifies severe wasting (169-171). I measured weight in grams using a standard Salter scale with minimal clothing and converted them into weight-for-height z-scores.

I also used underweight as a measure of weight for age of children up to 10 years of age (172). A child with a weight-for-age z score below or equal to -2 SD of the reference population is moderately underweight while a child below or equal to -3 SD is severely underweight. Finally, I used BMI-z scores as a measure of thinness among children aged above five years. A BMI-z score below or equal

to -2SD was considered moderate thinness, while below or equal to -3SD is severe thinness. All anthropometric calculations used WHO Anthro version 3.22 (172).

Feeding practices: To measure feeding practices, I assessed the most common measures, which are feeding frequency and dietary diversity. In this study, I assessed feeding frequency and dietary diversity separately.

I assessed feeding frequency by asking the caregivers to recall the number of times they fed their children in the previous 24 hours. This measurement was also used in previous studies in Tanzania among HIV-positive children (22, 173). I considered a feeding frequency below five to be a low feeding frequency. The WHO recommends a feeding frequency of at least five times a day for HIV-positive children (41, 42).

I measured dietary diversity using the dietary diversity scale (DDS) (174). The scale is made of common food items usually found in the area of interest. I extracted a list of twelve food items from the Tanzania Demographic and Health Survey (165, 175). The list of such food items included cereal based foods such as bread, maize based 'ugali', maize based porridge, millet, sorghum, and rice; yellow or orange tubers such as pumpkin, carrot; white tubers such as sweet potatoes, irish potato, white sweet potato, cassava, cocoyam, white yam; leafy vegetables such as marath, cassava green, pumpikin green, cabbage, and spinach; yellow or red fruits such as papaya or mango; any other vegetable or fruits; red meat such as muton or beef; poultry and other white meat; fish and other marine foods; eggs; legume foods such as beans, groundnuts, sunflower; diery products such as cheese, milk, and yourghut; and other foods from oil/fat such as margarine, ghee, and butter.

In my questionnaire, I asked caregivers about the food items they had given to their children in the previous 24 hours and summed them to make the total dietary diversity score. To establish the cutoff point for low dietary diversity, I used the median value, which was three. This value also coincided with the mean DDS of the lowest two terciles of the DDS score as recommended by the developer

(174). Therefore, a DDS score of three or below was considered low DDS. The DDS scale was also used in previous studies of HIV-positive children in Tanzania (167, 173).

Household food insecurity: I assessed food insecurity using the household food insecurity access scale (HFIAS) (176). HFIAS is a nine-item questionnaire used to measure the severity of food insecurity and household access to food according to a Likert scale. Options in this scale are 0 = 'no', 1 = 'rarely', 2 = 'sometimes', and 3 = 'often'. The lowest total score is 0 and the highest is 27. The scale can be used as a continuous variable or categorized into four groups: food secure, mildly insecure, moderately insecure, and severely insecure. HFIAS uses a recall period of 30 days and has been used in several studies within the region (8, 177-181). In this study, HFIAS had a Cronbach's alpha of 0.96, an item-rest correlation ranging from 0.63 to 0.89, and an average variance of 0.36.

HIV-clinical stage: To determine disease progression, I used the WHO clinical staging system, a four-stage classification system. I classified the first two stages as "early stages" and clinical HIV stages 3 and 4 as "advanced stages" (182). I retrieved the data on HIV stage from the medical files of each patient. The health workers update the clinical stage on a routine basis with each patient visit to the CTC.

ART adherence: I measured adherence to ART using a four-day recall. I asked patients whether they took their medications, when during the day, how many times each day, and how many pills each time. Based on the ART regimen, doctors can prescribe a once or twice a day dosage. For the twice a day dosage regimen, I considered missing one dose in four days as low adherence. For the once a day dosage regimen, I considered missing one in four day regimen as low adherence.

Opportunistic infections: To assess the burden of common opportunistic infections, I asked the caregivers whether their children had been affected by tuberculosis (TB), malaria, acute respiratory infections, or diarrhea in the past six months. As in previous studies (137, 167), I defined diarrhea as the presence of three or more watery stools during the previous 24 hours. I defined malaria as a febrile

illness with symptoms such as fever, chills and sweating, confirmed with laboratory investigation (183).

Socio-exonomic status: As in previous studies (167, 173) and other population surveys in Tanzania (165, 175, 184), I used a weighted wealth index to assess the economic status of households with HIV-positive children. The wealth index was calculated based on ownership of household durable assets. Factor analysis was used to reduce the constructed dichotomous variables from 59 to 22, which loaded as factor 1. I used tetrachoric command in STATA to compute estimates of tetrachoric correlations. This was because of the dichotomous variables created earlier for each item in the wealth index question. I treated the factor loadings as item weights summed to give the wealth index for each household like in the previous studies (185-187). I summed up the assigned weighs of each variable to assign weighted wealth index for each household where a child reside. The resulted latent variable was a continuous variable. This was later divided into three equal categories (terciles) to make low, middle and upped wealth index. The categorical variable was used for descriptive statistics while the continuous variable was used for regression analyses.

Socio-demographic characteristics: I adopted other socio-demographic variables from the women and household questionnaires of the TDHS (165, 175). The population surveys tested and used such variables in both 2005 and 2010 in Tanzania. Such variables included caregivers' education level, child's orphanhood state, sex, and age. I defined a caregiver as being a child's parent, relative, guardian, or anyone else above 18 years old who takes care of the child and supervises their treatment or accompanies them to the CTCs (167). I measured education level according to the education levels in Tanzania and divided them into three levels: no formal education, having a primary level education, and above primary level, including secondary, college, and others. A child who lost one or both parents was regarded as an orphan (165, 175).

4.2.4 Data collection

I collected data using a pre-tested questionnaire. I conducted a one-day training of two research assistants from each CTC on interview techniques, questionnaire content, and ethics in data collection. I collected data through face-to-face interviews and retrieved medical data from medical records from April to May 2013.

For the focus group discussions, I used an IC recorder to record the participants' discussions. Before each discussion, participants introduced their age, occupation, marital status, and number of children they care for. The moderator, who is the first author, introduced the study, explained its aims, and set ground rules. The stem questions asked by the moderator sought to find the local factors associated with undernutrition in the region despite its known vast food production, participants' feeding practices, food access, the role of nutrition education, occurrence of opportunistic infections, and local challenges encountered when feeding HIV-positive children in each district. Finally, participants were given opportunities to suggest their local solutions and what they needed from the health workers to combat poor feeding practices and undernutrition among HIV-positive children and those of the general population. All discussions were conducted in Swahili language. The conduct and reporting of the FGDs was in accordance with the consolidated criteria for reporting qualitative research (COREQ) (188).

4.2.5 Data analysis

I conducted analysis using both descriptive and regression methods. For descriptive analyses, I used Chi-square tests to compare the characteristics of participants. A similar method was used to examine the magnitude of undernutrition and feeding characteristics presented in categorical variables while comparing them between males and females. I conducted bivariate linear regression to examine association between independent variables and dependent variables. In this case, I examined factors associated with each type of undernutrition. Statistical associations with p-values below or equal to 0.2 were entered into a multivariate regression to find factors associated with undernutrition after adjusting for confounders and important covariates (189).

Multivariate regression analysis models were therefore built based on the results of assiciations between independent variable and the outcome variable (nutrition status). Such variables included at the bivariate were factors associated or known to affect nutrition status in previous studies or conceptual frameworks in general populations and HIV-positive children.

For stunting model factors included in the multivariate regression analysis included: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, TB, malaria, ARI, HIV stage, and adherence. For wasting model thse factors included: age, sex, education level, wealth index, food insecurity, food frequency, malaria, ARI, and HIV stage. For underweight model I included: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, TB, diarrhea, malaria, ARI, and HIV stage. Finally, for thinness model I included: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, and TB.

Age and sex variables were included in the multivariate regression models regardless of their association with undernutrition at bivariate regressions. This is because of the importance of these variables in nutrition status calculations and associations found in previous studies.

Feeding frequency was low and associated with most of the nutrition status measures. Therefore a separate model was built to examine factors associated with feeding frequency among HIV-positive children attending CTCs in Tanga region. For this model, independent variables included sex; household wealth index; caregivers' education level; orphanhood; household food insecurity access score; acute respiratory infection or diarrhea in the past six months; and ART adherence. These factors thought were found to affect feeding practices in other studies.

In both models, I examined multicollinearity using variance-inflating factors (VIF). None of the independent variables had a VIF value above 10 or below 0.1. I set the statistical significance at p-$value<0.05$. I conducted all analyses using STATA version 12.

For the qualitative data, a research assistant transcribed the recorded focus group discussions into Swahili scripts. A separate research assistant then translated each of the Swahili scripts into English. A local expert on qualitative research checked for quality of each step. I analyzed the transcribed text based on the themes that emerged from the discussion (190). All the involved researchers were native Swahili speakers.

4.2.6 Ethics statement

I obtained written consent from participants before the interviews and focus group discussion. Participants were assured of confidentiality and anonymity throughout the process and for all reports and publications generated. Participation was voluntary and there were no implications for care at the CTC upon refusal to participate. This study was approved by the Research Ethics Committee of the University of Tokyo, and the Expedited Review Sub-committee of the Senate Research and Publication Directorate of the Muhimbili University of Health and Allied Sciences.

4.3 Results

4.3.1 Quantitative study

4.3.1.1 General characteristics

I recruited 63.8% of all HIV-positive children attending the nine selected CTCs in Tanga region. Of the 748 HIV-positive children in this study, 666 (89.0%) were on ART. Of those on treatment, 85.3% had high adherence to the treatment. Of all children included in this study, 69.6% were in the advanced HIV clinical stage. Among the 666 HIV-positive children on ART, 75.7% were in the advanced HIV clinical stage. In this respect, no differences were observed between male and female participants.

Table 14 shows that two thirds (66.7%) of the children had lost at least one parent. A high proportion of their caregivers (22.1%) had no formal education while only 7.6% of all caregivers had at least secondary education.

Table 14: Descriptive characteristics of HIV-positive children attending CTCs in Tanga

Variable	Total		Male		Female		p-value
	n	%	n	%	n	%	
Age (months)							
6-59	152	20.3	81	23.7	71	17.5	0.105
60-143	422	56.4	183	53.5	239	58.9	
144-168	174	23.3	78	22.8	96	23.6	
Parental status							
Non-orphan	249	33.3	122	35.7	127	31.3	0.204
Orphan	499	66.7	220	64.3	279	68.7	
Caregiver education							
None	165	22.1	73	21.3	92	22.7	0.852
Primary	526	70.3	244	71.4	282	69.4	
>Primary	57	7.6	25	7.3	32	7.9	
Wealth index							
High	251	33.6	123	36.0	128	31.5	0.327
Middle	248	33.2	105	30.7	143	35.2	
Low	249	33.2	114	33.3	135	33.3	
ART status							
Yes	666	89.0	303	88.6	363	89.4	0.490
No	82	11.0	39	11.4	43	10.6	
HIV stage							
Early	227	30.4	101	29.5	126	31.0	0.656
Advanced	521	69.6	241	70.5	280	69.0	
ART adherence							
Low	98	14.7	49	16.1	49	13.5	0.349
High	568	85.3	255	83.9	313	86.5	
Household food security							
Food secure	146	19.6	70	20.5	76	18.8	0.899
Mild insecure	46	6.2	22	6.5	24	5.9	
Moderate insecure	112	15.0	49	14.4	63	15.6	
Severe insecure	442	59.2	200	58.6	242	59.7	

CTC- Care and treatment center; ART- Antiretroviral therapy; HIV- Human immunodeficiency virus

4.3.1.2 Feeding practices and nutrition status of HIV-positive children in Tanga

HIV-positive children in this study had a mean dietary diversity score of 3.3 (SD 1.3) and a mean feeding frequency of 3.2 (SD 1.0). The WHO's standard recommended feeding frequency for this population is ideally five times a day. As shown in **Table 15**, a high proportion of HIV-positive children (88.1%) were fed at a low frequency. Feeding frequency did not differ between male and female participants. A high proportion of HIV-positive children (62.3%) had a low dietary diversity score.

HIV-positive children also presented with a high burden of undernutrition. A high magnitude (61.9%) of HIV-positive children attending CTCs had moderate to severe stunting. Moderate to severe underweight was also prevalent among 38.7% of children below ten years of age. More than one quarter (26.0%) of HIV-positive children aged between six months and five years presented with moderate to severe wasting. Moderate to severe thinness was prevalent among 21.1% of HIV-positive children aged six years and above. For all types of undernutrition, there were no statistical differences between male and female children **(Table 15)**.

Table 15: Magnitude of poor feeding practices and nutrition status

Nutrition status	Male		Female		Total		p-value
	n	%	n	%	n	%	
Feeding Frequency							
Low	298	87.1	361	88.9	659	88.1	0.454
High	44	12.9	45	11.1	89	11.9	
Dietary Diversity Score							
Low	220	64.3	246	60.6	466	62.3	0.293
High	122	39.7	160	39.4	282	37.7	
Wasting (≤ 60 months)							
Wasted (WHZ ≤-2SD)	29	30.2	18	21.2	47	26.0	0.167
Normal (WHZ>-2SD)	67	69.8	67	78.8	134	74.0	
Thinness (>60 months)							
Thin (BMIZ ≤-2SD)	56	23.1	62	19.6	118	21.1	0.316
Normal (BMIZ>-2SD)	187	76.9	255	80.4	442	78.9	
Underweight (≤120 months)							
Underweight (WAZ≤-2SD)	95	40.6	103	37.1	198	38.7	0.412
Normal (WAZ>-2SD)	139	59.4	175	62.9	314	61.3	
Stunting (6 months-14 years)							
Stunted (HAZ≤-2SD)	208	60.8	255	62.8	463	61.9	0.577
Normal (HAZ>-2SD)	134	39.2	151	37.2	285	38.1	

WHZ- Weight-for-height z-score; BMIZ- Body Mass Index-for-age z-score; WAZ- Weight-for-age z-score; HAZ- Height-for-age z-score

4.3.1.3 Determinants of undernutrition among HIV-positive children attending CTCs

Table 16 shows the results of regression analysis on the factors associated with undernutrition among HIV-positive children attending CTCs with their caregivers. After adjusting for covariates and confounders, a unit increase in age of HIV-positive children (in months) was associated with poor linear growth ($\beta = -0.35$, p<0.001). Compared to uneducated caregivers, caregivers with at least primary education had a lower chance of having stunted children ($\beta = 0.87$, p = 0.035). Household food insecurity was also associated with children's poor linear growth ($\beta = -0.01$, p = 0.027). Low feeding frequency was also associated with poor linear growth among HIV-positive children ($\beta = 0.11$,

p = 0.016). Malaria episodes in the past six months and advanced HIV clinical stage were also associated with poor linear growth among HIV-positive children.

Wasting was associated with age and HIV clinical stage **(Table 16).** Compared to older children, younger children were more likely to experience wasting ($\beta = 0.20$, p = 0.009), and an increase child's HIV clinical stage from early to advanced was associated with severity of wasting ($\beta = -0.25$, p = 0.001). Feeding practices were not significantly associated with wasting among children of this population.

Food insecurity, feeding frequency, malaria, and HIV clinical stage were associated with poor weight gain for age after controlling for covariates and confounders (**Table 16**). Household food insecurity was associated with underweight ($\beta = -0.17$, p = 0.003). Low feeding frequency was also associated with poor weight gain for age among HIV-positive children ($\beta = 0.12$, p = 0.029). Having malaria in the past six months ($\beta = -0.14$, p = 0.002) and advanced HIV clinical stage ($\beta = -0.14$, p = 0.001) were associated with poor weight gain among children in this population.

Factors associated with thinness included age in months, feeding frequency, and ART use (**Table 16**). After adjusting for covariates and confounders, a unit increase in age of HIV-positive children (in months) was associated with poor body mass index for age ($\beta = -0.28$, p < 0.001). Low feeding frequency was also associated with poor body mass index for age among HIV-positive children ($\beta = 0.11$, p = 0.026). HIV-positive children on ART were more likely to have poor body mass index for age compared to those not on ART ($\beta = -0.12$, p = 0.002).

Table 16: Regression analyses of factors associated with undernutrition among HIV-positive children

Variable	Stunting (HAZ-score), n=661				Wasting (WHZ-score), n=181				Underweight(WAZ-score), n=458				Thinness (BMIZ-score), n=592			
	Bivariate		Multivariate*		Bivariate		Multivariate*		Bivariate		Multivariate*		Bivariate		Multivariate*	
	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p
Age	-0.32	<0.001	-0.35	<0.001	0.17	0.024	0.20	0.009	-0.04	0.363	-0.06	0.180	-0.27	<0.001	-0.28	<0.001
Sex	-0.07	0.071	-0.06	0.076	0.06	0.413	0.06	0.411	0.05	0.308	0.31	0.484	0.06	0.182	0.04	0.353
Education																
Primary	0.15	<0.001	0.87	0.035	0.16	0.841	0.02	0.808	0.09	0.095	-0.01	0.942	-0.01	0.950	-0.05	0.273
>Primary	0.10	0.011	0.36	0.395	0.11	0.195	0.07	0.451	0.18	0.001	0.07	0.196	0.13	0.008	0.06	0.186
Wealth index	0.11	0.002	-0.02	0.606	0.15	0.036	0.09	0.294	0.17	<0.001	-0.01	0.790	0.08	0.053	0.01	0.876
Food insecurity	-0.20	<0.001	-0.01	0.027	-0.15	0.038	0.06	0.541	-0.29	<0.001	-0.17	0.003	-0.13	0.002	-0.08	0.134
Food frequency	0.18	<0.001	0.11	0.016	0.14	0.054	0.05	0.601	0.25	<0.001	0.12	0.029	0.14	0.001	0.11	0.026
Dietary diversity	0.17	<0.001	0.08	0.050	0.08	0.305			0.20	<0.001	0.07	0.165	0.08	0.074	-0.01	0.972
TB	-0.07	0.070	-0.06	0.096	-0.04	0.579			-0.09	0.053	-0.07	0.111	-0.07	-0.103	-0.07	0.066
Diarrhea	-0.04	0.261			-0.08	0.267			-0.07	0.160	-0.04	0.452	-0.04	0.365		
Malaria	-0.71	0.051	-0.09	0.013	-0.17	0.020	-0.12	0.119	-0.16	0.001	-0.14	0.002	0.03	0.438		
ARI	-0.05	0.163	0.03	0.350	-0.15	0.051	-0.13	0.120	-0.12	0.008	-0.01	0.826	0.01	0.840		
HIV stage	-0.12	0.001	-0.12	0.001	-0.25	0.001	-0.25	0.001	-0.18	<0.001	-0.14	0.001	-0.03	0.461		
ART	0.03	0.479			0.09	0.227			0.03	0.565			-0.11	0.011	-0.12	0.002
Adherence	0.05	0.177	0.03	0.423	0.02	0.849			-0.03	0.501			-0.05	0.276		

* Variables in multivariate regression models: Stunting model: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, TB, malaria, ARI, HIV stage, and adherence; Wasting model: age, sex, education level, wealth index, food insecurity, food frequency, malaria, ARI, and HIV stage; Underweight model: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, TB, diarrhea, malaria, ARI, and HIV stage; Thinness model: age, sex, education level, wealth index, food insecurity, food frequency, dietary diversity, and TB

Model fit (R^2): Stunting model=20.5%; Wasting model=14.7%; Underweight model=15.3%; Thinness model=13.0%

4.3.1.4 Factors associated with feeding frequency

Table 17 shows the results of bivariate and multivariate regression analysis for the factors associated with feeding frequency among the HIV-positive children attending CTCs. Children residing in households with a low wealth index were less likely to have a high feeding frequency ($\beta = 0.06$, $p < 0.001$) so were children whose households had high levels of food insecurity ($\beta = -0.05$, $p < 0.001$). HIV-positive children whose caregivers had higher than primary school education were more likely to have higher feeding frequency compared to those whose caregivers were not educated ($\beta = 0.34$, $p = 0.015$), Finally, having acute respiratory tract infections in the previous six months was associated with low feeding frequency among HIV-positive children ($\beta = -0.23$, $p = 0.001$).

Table 17: Factors associated with feeding frequency

Variable	Bivariate regression			Multivariate regression* (n=664)		
	Coefficient	Beta	P-value	Coefficient	Beta	p-value
Age (months)	-0.01	-0.05	0.160	-0.01	-0.04	0.201
Sex	-0.06	-0.03	0.401	-0.10	-0.05	0.138
Education						
None	1.00					
Primary	0.43	0.20	<0.001	0.07	0.03	0.420
>Primary	0.93	0.26	<0.001	0.34	0.09	0.015
Wealth index	0.17	0.38	<0.001	0.06	0.14	<0.001
Food insecurity	-0.06	-0.49	<0.001	-0.05	-0.39	<0.001
TB	0.13	0.03	0.344			
Diarrhea	-0.26	-0.13	<0.001	-0.04	-0.02	0.563
Malaria	-0.01	-0.01	0.982			
ARI	-0.53	-0.26	<0.001	-0.23	-0.11	0.001
HIV stage	-0.02	-0.01	0.811			
ART	0.08	0.03	0.459			
ART adherence	0.15	0.13	0.001	0.04	0.04	0.286

Acronyms: TB- Tuberculosis; ARI- Acute respiratory infection; ART- Antiretroviral therapy

   * Variables included in the multivariate regression analysis: age, sex, caregivers' education level, wealth index, food insecurity, diarrhea, acute respiratory tract infection and ART adherence Model fit (R^2) = 29.4

4.3.2 Results of the focus group discussions

I identified seven major and important themes from the seven focus group discussions that were conducted. The themes evolved from the locally identified determinants of undernutrition and poor feeding practices. They included low feeding frequency and dietary diversity, food insecurity, poverty and low income, and opportunistic infections. These four themes were related to the factors associated with undernutrition in the quantitative survey. Three other themes emerged that were unrelated to the quantitative survey: stigma, lack of nutrition education or misconceptions, and traditions and ways of life.

4.3.2.1 Feeding frequency and dietary diversity

In this study, low feeding frequency was a common practice among participants. Caregivers fed their children twice a day or at the same frequency as adults or otherwise normal children.

> *"...my children eat only twice a day although I am a food vendor. In the morning I give them porridge until at 4 PM, when they eat the last meal of a day. We skip lunch because we cannot afford it. I prefer giving the last meal closer to night just to make them survive."* (A 26-year-old food vendor and mother of two HIV-positive children)

Participants explained that when they increased their children's feeding frequency, their nutrition statuses improved.

> *"My child's hair was so weak, so thin, and she had a large abdomen and thin legs. I was told that she had kwashiorkor. This was when her biological mother had just died. She was checked for worms, and treated for it, also given Septrin (an antibiotic given routinely for HIV-positive children). I started to give her more food, many times a day. As a result, she started to thrive. She was later started on ARV, and now she looks healthy, all symptoms of kwashiorkor are gone."* (A 28-year-old caregiver and mother of four children)

Increasing feeding frequency also showed improvements in micronutrients profiles. It happens when the quality of diets is improved among children living with HIV.

> *"I did not feed my child five times a day. Instead, I gave her three times just like the rest of the family including adults. When I came to hospital, she was found to have low weight, failed to grow, and had low blood contents. I then started to feed actively, especially fruits, vegetables, mixing porridge with peanuts…. she started to grow healthy, her blood contents increased, and weight too, even other diseases had stopped."* (A 28-year-old married woman, mother of three children, one being HIV-positive)

HIV-positive children in Tanga are fed with fewer food types. Caregivers pointed to a lack of money to buy other types of food although such foods are available in the markets.

> *"...nowadays, we cook only once a day, either plain corn porridge or stiff porridge, so the child eats only what is available in the morning until evening. If we are lucky to have something to eat at night, we give her otherwise we sleep hungry. We are taught to give them mixture of eggs, meat, milk, and vegetables. Although these foods are available, we can not afford them."* (A 50-year-old caregiver, mother of four children and a small-scale farmer)

Caregivers may be given nutrition education on how to mix foods for their children. But many of them still consume a mixture of similar types of foods unknowingly. These foods have similar nutrition contents and might not provide added benefits, no matter the number of items included or frequency at which they are fed.

> *"...in her porridge, I mix flour from corn, millet, sorghum, rice, and other cereals. I was advised to mix a variety of foods to improve nutrition. This porridge I give many times in a day."* (A 24-year-old mother of two who is also an entrepreneur, selling a similar mixture to her peers)

> When asked who taught her this mixture, she said, *"This is what I was taught by my nurses here."*

Giving high dietary diversity can improve nutrition status and even physical body functions. Several caregivers explained that their children had improved after they received nutrition advice to increase diversity.

"My child had poor health, weak, and very thin when I started her in this clinic. She could not stand up by herself or play, although she had the age of a child who could walk and run. She started ARV, and I was given nutrition advice, which I followed, I started to give milk, adequate volumes of various foods, and fruits everyday. Her health status improved, and gained weight. She could then play and walk." She went on and say, "I have stopped giving that quality foods now because, now I can not afford it… we cook only once for what we have…I cannot give milk, I can't even cook with cooking oil…as a result, she is falling back so fast." (A 30-year-old farmer and caregiver of seven children)

4.3.2.2 Food insecurity and hunger

The HIV-positive participants mentioned that low food availability in their households is common because they cannot do manual farm work due to their health conditions. They have low purchasing power for foods despite being available in the markets. As a result, they cannot have the recommended feeding frequency and dietary diversity. Ultimately, their children suffer from undernutrition.

"I am a farmer, and depend on agriculture. Last year for example, it did not rain enough. We did not get harvests, especially corn. Foods were little and less diverse…we did not have income, and could not even buy enough foods from markets. This child ate less and lost weight. When this child is sick with fever, he wants to eat some good foods; it was impossible for him to get it. He did not want to eat stiff porridge available all day, everyday." (A 56-year-old grandmother of an HIV-positive child)

"For farmers like me, sometimes, we do not harvest enough because we depend on rain and can do it manually with hand hoe, so we cannot cultivate enough because of our health. Our yields are low and we are in a constant food shortage." (A 59-year-old widow and farmer)

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4.3.2.3 Poverty and low income

Participants pointed to poverty and low income as an underlying cause of poor feeding practices and undernutrition among HIV-positive children in this region.

" ..now life has become so difficult. I am sick, and cannot do hard work, especially farming. It causes children to lose weight because good food requires a lot of money. I do not have income. I know that milk is important especially when you use strong medications like ARVs, but, I can stay one year before I or my child could drink it. Sometimes in my family we sleep without eating anything... my child goes to school without breakfast. When I am well I go to work, and get paid 2000 shillings for example, I can only afford to buy basic cheap food. That is why children are undernourished." (A 50-year-old mother of four children)

"...low income is the reason for undernutrition. I struggle to look for money, the child eat only twice, in the morning and then at evening even when I myself sell food and fruits...when my husband died, he left us a little money. My family income suddenly dropped. I am the only person who has to provide for my family and it is not enough." (A 37-year-old mother of two)

4.3.2.4 Opportunistic infections

HIV suppresses immunity leading to opportunistic infections. Participants in this study gave examples where undernutrition of their children resulted from such infections.

"My child had swellings on his neck. During the time of this illness, he was not eating well, and complained of painful swallowing. He became wasted, like those people who are real sick of AIDS. But after medication (not ARVs), he improved; now he eats well and his weight gained." (A 31-year-old mother of two children)

Tanga is also an endemic area for malaria transmission. Participants also explained how malaria contributed to their children's poor nutrition status.

"This week, my child was sick of malaria, she could not hold food, she has fever, and she also has oral curd-like condition they say is fungus. She has pain when eating and has lost too much weight... her suffering gives me depression." (A 32-year-old mother of two HIV-positive children)

4.3.2.5 Stigma related to HIV status and child undernutrition

Participants indicated that stigma against people living with HIV can lead to a child's poor health including undernutrition. For example:

"Another problem is stigma. Colleague of my child tells her at school that she has AIDS... this created stigma. As a result, she lost hope at first then refused to eat; at the end she lost weight. She told me that her friends did not want to play with her. People in our society stigmatize our children and us. Even if we feed them with whatever food available, the stigma they face weakens them physically and psychologically." (A 24-year-old entrepreneur and mother of two HIV-positive children)

"...another reason is stigma especially for those who are older children attending schools. They are isolated and mocked. They feel weak and lose hope. Their feeding deteriorates even in the presence of enough food as well." (A 20-year-old mother of one HIV-positive child)

Stigma also exists within families. A 30-year-old housewife and mother to two while caring for her late sister's HIV-positive child said:

"My husband leaves money for his children's food only, not for this HIV-positive one. Even when I leave some for this affected child, he does not like it, and get mad at me."

4.3.2.6 Lack of nutrition education or misconceptions, and traditional beliefs

In the current study, caregivers had low levels of nutrition knowledge especially of adequate feeding frequency, proper dietary diversity, and mixing of foods for young HIV-positive children.

"Majority of us do not understand what is a good quality food. Education on nutrition is lacking…we have our myths from our traditions. We thought that artificial juice had equal nutrition values as natural juice based on fruits available in our environment, such as pawpaw, mangoes, oranges, banana, etc. I would like to know how to make them. With such knowledge, I believe, I will be able to make right decisions on foods. All quality food substances are available I believe, I just need to understand how to combine them in to a quality diet. For example, if I cannot afford meat, what else should I replace with? What cheap options can I substitute with?" (A 33-year-old father of four children)

A 19-year-old participant thinks that vegetables are not 'good food' as it is the food of poor, and said *"I eat vegetables a few days only when I do not have money for alternatives like red meat."* She added, *"Good food is anything other than green vegetables. Vegetables are not considered as good food here. In our normal diet we do not eat them, even when available."*

4.4 Discussion

HIV-positive children attending CTCs had poor nutrition status despite vast food availability in the Tanga region. For example, 61.9% of all recruited HIV-positive children were stunted; 38.7% of HIV-positive children below ten years were underweight; 26.0% of HIV-positive children between six months and five years had wasting; and 21.1% of HIV-positive children above five years were thin. Feeding practices of HIV-positive children attending HIV care and treatment centers were poor. Among the children recruited to participate in this study, 88.1% had a feeding frequency below the recommended value of five times a day. About two thirds of the children had dietary diversity scores of three or below. Triangulated evidence of the quantitative and qualitative studies showed that the poor feeding practices in Tanga region were associated with undernutrition in this region. Regression analyses of factors associated with different types of undernutrition pointed to feeding frequency as a common risk factor for stunting, underweight, and thinness. This is the first study to demonstrate the high magnitudes of poor feeding practices among HIV-positive children in areas known to have adequate food production and its association with undernutrition.

Magnitudes of poor nutrition status in this food rich region among HIV-positive children was higher compared to the general population (164). For example, while 49.0% of children in the general population were stunted, 61.9% of the HIV-positive children in this study were stunted. Similarly, for all other types of undernutrition, magnitudes were higher in this study than in the general population. Contrary to my prior thoughts, magnitudes of undernutrition among HIV-positive children in this food secure region were also higher compared to those of ART-treated HIV-positive children in another city in Tanzania (167). As in my previous study (167), ART status did not have a statistically significant influence over nutrition status of most types of undernutrition.

This study found an inverse association between age in months and linear growth. Stunting is a chronic form of undernutrition resulting from the cumulative effects of food shortages and poor feeding practices (64). Compared to other forms of undernutrition, stunting is an irreversible condition. Its effects are long term and can result in poor brain and intellectual development. The results are different

from another study I conducted in another city in Tanzania (167). Results of the qualitative study showed that low feeding frequency, low amounts, and limited variety of feeding were also common and contributed to poor nutrition statuses.

Low feeding frequency was associated with stunting, underweight, and thinness among HIV-positive children in this study. Similar conclusions were made for stunting, wasting, and underweight in my previous study among HIV-positive children in a different city in Tanzania (167). WHO recommends a feeding frequency of at least five times a day to provide for the high energy and nutrients demand among HIV-positive children (41). Improvement in feeding frequency and other feeding practices can bring about positive changes in nutrition status among children in the general population (56). My study strengthens the need for improvement in feeding practices, particularly feeding frequency, in the fight against undernutrition.

In this study, overall feeding practices of HIV-positive children were poor, despite food production being high in the region. Households of HIV-positive children also had high levels of food insecurity; about three quarters of the children resided in households with moderate to severe food insecurity. Caregivers of HIV-positive children, in particular, may therefore not be able to provide enough food for their families even if general food availability in the area is good (7). As in other regions in Tanzania (167), such caregivers may succumb to socio-economic disadvantages and are also prone to a high burden of opportunistic infections as they are also more likely to be HIV-positive. The main sources of food in this region are small-scale farming and animal husbandry. Therefore, poor families with no or small farmlands, or HIV-positive people who are not strong enough to do the manual labor required on a farm, may have less food for their households. This in turn may lead to a chronic shortage of food and may bring about low dietary diversity and inadequate intake of nutrients (23, 157).

Feeding frequency might also be affected in a similar way. In this study, an independent association was detected between feeding frequency among households affected by food insecurity and poverty.

Results from focus group discussions among caregivers of HIV-positive children also showed that households with food insecurity were more prone to low feeding frequency of their children. Because of the lack of food, children ate twice a day on most occasions. Similar results were observed in Ethiopia among adolescents with unknown serostatus (191) and HIV-positive adults.(192) However, these areas have been known to have long periods of hunger and food insecurity, characteristics that differ from my study.

Feeding practices, and in particular feeding frequency, were also associated with the caregiver's education level. In this case, even when food is available at the household level and other factors are controlled for; caregivers with low education levels may not provide foods to their children at the recommended frequency. More than one fifth of the caregivers of HIV-positive children in this population were not educated. In the qualitative study, too, caregivers had little knowledge of nutrition and how to feed their children. There were many misconceptions based on local beliefs and traditions that also led to wrong choices of foods. The level of education may determine nutrition knowledge (193). When caregivers are given such knowledge, they improve feeding practices, including feeding frequency and dietary diversity, of their children (50, 134, 192, 194).

Poor feeding practices were associated with a burden of other diseases. For example, low feeding frequency was associated with the chance of having had acute respiratory tract infections at the same time. Such acute diseases are especially common among children with HIV and undernutrition (16). Results from my qualitative study may help to explain this phenomenon. Because of low immunity, HIV-positive children who are also affected by undernutrition are prone to other infections including upper respiratory tract infections. Children with these conditions improved upon proper feeding in adequate amount and frequency.

The results of this study should be interpreted with care owing to the following study limitations. First, the nature of my cross-sectional design limits the conclusions on causality. For example, the direction of associations between feeding practices and infections such as respiratory tract infections cannot be

ascertained. However, triangulation of the quantitative and the qualitative study can help further explore such associations, though it is not sufficient to ascertain causality. Previous models have also suggested the association between diseases such as malaria and respiratory tract infections with undernutrition is possibly through poor feeding practices among HIV-positive children (195).

Second, some of scales used in this study were based on self-reporting by caregivers of HIV-positive children. Such scales include feeding practices (feeding frequency and dietary diversity), food insecurity, and other demographic characteristics. To reduce the risk of caregivers from forgetting the correct answers, I chose scales that go back as far back as one day (in the past 24 hours) for feeding practices and the past six months for the food insecurity scale. Similar scales have been used elsewhere including Tanzania in previous studies with success.

Third, my findings may not be generalizable beyond the settings of high food productivity. Evidence already exists on the high magnitude of poor feeding practices among HIV-positive children in general settings (3) and in food insecure areas among HIV-negative (191) and HIV-positive adults (192). Fourth, the reliability of my measurement for ART adherence may be questionable, as it was not validated in scientific articles from the settings of this study. However similar method is being used in CTC clinics to monitor ART adherence and conduct adherence counseling. Fifth, I did not translate the translated script from Swahili to English, to the original Swahili language to compare with the original script. This could have lead to the unintended translation. However, I supervised the overall translation process and I am fluent both in English and Swahili language and tried to avoid the fatal misunderstandings.

In conclusion, HIV-positive children attending care and treatment centers in Tanga, a region with adequate food production, had poor nutrition statuses and low feeding frequency and dietary diversity scores. Low feeding frequency was associated with stunting, underweight, and thinness. Factors associated with low feeding frequency included low wealth index, low maternal or caregiver education, household food insecurity, and acute respiratory tract infections in the past six months.

To ameliorate the high burden of undernutrition among HIV-positive children, feeding practices, in particular feeding frequency, should be improved even in areas where food production is high and food is available at low cost. To achieve this, more focused interventions may be necessary to help HIV-positive children in those households that face high food insecurity, poverty, and low education of caregivers. Nutrition training of health workers can help provide this support, reduce misconceptions regarding healthy foods (196), and help caregivers utilize efficiently and well the vast food availability in the region (50). Nutrition counseling may also teach methods of food storage households who are affected by food insecurity but live in food rich regions (41). Frequent nutrition counseling can help to guide such families into proper use of available resources including foods and give priorities to children with high nutritional demand.

Chapter 5:

Nutrition training of midlevel providers - A key to improving feeding practices and weight gain of HIV-positive children in Tanga, Tanzania: a cluster-randomized controlled trial

5.1 Introduction

The global burden of child undernutrition is declining. However, the rates still vary widely among low-income countries (197), with the brunt of the burden of undernutrition still falling on just a few (35). For example, only 14 countries – all low-income – harbor 80% of the world's stunted children (35). Poor feeding practices (154), food insecurity (8), and poverty are important factors behind such rates of undernutrition. These countries also suffer from heavy burdens of HIV, which further worsens child undernutrition (22).

Undernutrition among HIV-positive children in low-income countries is largely associated with poor feeding practices, low education levels among caregivers, and poverty. Food insecurity is persistent among families of HIV-positive children and is also associated with child undernutrition (8, 49). Even in regions with high food production, HIV-positive children are subject to high levels of undernutrition (23, 157). In such regions, caregivers with poor nutrition knowledge have high chance of feeding their children with a low quality and diversity of foods and at a lower frequency than recommended (7, 23). Improving nutrition knowledge within such contexts may help to ameliorate child undernutrition.

Caregivers' nutrition knowledge can be improved if they are properly counseled on proper feeding practices based on the local food availability (41). To achieve this, health workers should first be provided with updated nutrition knowledge, skills, and competence to manage undernutrition. Such skills can be acquired through inservice nutrition training (54, 80). Nutrition training of health workers has also been effective to improve feeding practices including feeding frequency, dietary diversity, and adequacy (50). Thus, nutrition counseling by trained health workers has the potential to improve the growth (56) and livelihood of children in the general population (58).

Although evidence is available among children of general populations, evidence on the efficacy of nutrition training and counseling among HIV-positive children remains lacking, despite the higher risk of undernutrition and mortality faced by such groups. Moreover, typical inservice nutrition training has involved qualified health workers such as qualified nurses, nutritionists, dieticians, clinicians, and

other specialized health workers (76, 80, 136, 146, 148). Just a few nutrition training interventions have also included community health workers and non-medical personnel (59-61). No study, meanwhile, has reported on any nutrition training being provided to midlevel providers (MLPs).

MLPs are health workers trained for 2-3 years post secondary school. In developing countries, MLPs undertake tasks that are usually carried by qualified nureses and medical doctors (198). They constitute the majority of health workers in such countries, including Tanzania (198). Because of health workforce shortages (199), MLPs in Tanzania are left to work in rural and semi-urban areas, where a high number of patients also reside (198). Their training may not be adequate to make them competent to treat complex medical conditions such as severe undernutrition of HIV-positive children with other complications. However, they may be the only available workforce to provide such highly demanding care, with minimal support or trainings in some areas. Therefore, this study had two objectives: first to examine the efficacy of MLPs' nutrition training to improve their nutrition knowledge, and second to examine the efficacy of such training to improve caregivers' feeding practices along with the anthropometry and nutrition status of HIV-positive children.

5.2 Methods

5.2.1 Study design

I conducted this cluster-randomized trial in care and treatment centers (CTCs) in Tanga region, Tanzania. The CTC was taken as the unit of randomization. Details of the selected CTCs are in the previous chapter and published protocol (65). The present trial was first registered in the Current Controlled Trials database, under the following registration number: ISRCTN65346364. The protocol for this trial was later peer reviewed and published (65). This trial followed the CONSORT guide for reporting of trials.

5.2.2 Study area

I conducted this study in HIV Care and Treatment Centers (CTCs) in Tanga, the North Eastern region of Tanzania. Tanga is a costal region with varied climatic conditions that allow diverse food production. Even if sisal market exports are lost, Tanga remains one of the main producers of cereals and fruits, and these make up a large part of its major economic activities.

Tanga is a food secured region; however, it has an unacceptably high proportion of child undernutrition. For example, in the nationally representative survey in 2010, more than 49% of the 315 under-five children surveyed in Tanga region were stunted (165). Acute undernutrition among them is also rampant; about 12% of the 315 underfives were underweight while 5.5% were suffering from wasting. The regional diversity in food production does not reflect diversity in consumption. For example, Tanga produces various cereals, fruits, vegetables, and both fresh and sea water products; however, only 59.4% of the 292 children aged 6-60months sampled from the general population consumed foods rich in Vitamin A (164). The proportion of Vitamin A deficiency among these children was 38.9% while iron deficiency was 36.5%. Iron deficiency anemia in the same population was 52.2% (164). Data of nutrition profiles of HIV-positive children in this region is not available.

Undernutrition is even more rampart among HIV-positive children attending CTCs in this region. In the formative research study (Chapter 4), that preceded the current cluster-randomized controlled trial,

about 62% of 748 HIV-positive children recruited were stunted (49). About 39% of them also suffered from low weight for their age. The recruited children had poor feeding frequency and dietary diversity (49). Reasons proposed for such poor feeding practices included poor caregivers' nutrition knowledge, food insecurity in families of HIV-positive children, and poverty.

The region is also not spared by HIV epidemic. The prevalence of HIV infection in the region is estimated to be 2.4%, based on a sample of 833 adults aged 15-49 years from the region who were tested as part of a nationally representative survey (184, 200).

CTCs are specialized clinics to care for HIV-positive people, including children. They operate under vertical HIV programs and are integrated into the existing health infrastructure (168). In Tanga, all CTCs are located in health facilities. They provide care and treatment to HIV-positive people including voluntary counseling and HIV testing; prescribing and dispensing ART; ART adherence counseling; diagnosis and treatment of opportunistic infections; monitoring response to treatment and disease progress; behavior change promotion; and outreach services, among others (168, 200). HIV-positive people attend CTCs every month to get ART refills. In each visit, they also receive adherence counseling and monitoring, examination by clinicians, and management of opportunistic infections if any (168, 200).

Until December 2012, Tanga region had had a total of 32 CTCs. They are distributed throughout the region based on population density and the needs of specific areas. All districts have CTCs located in the district hospital and health centers. A total of 20,773 people living with HIV were enrolled in these CTCs by the year 2009 (200). According to the regional unpublished data, about 1,800 HIV-positive children were enrolled at CTCs for care and treatment as of March 2013.

Figure 4: Flow diagram of the cluster RCT

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                              ┌──────────────────┐
                              │   32 CTCs        │
                              │   assessed for   │
                              └──────────────────┘          ┌──────────────────────┐
                                       │                    │   16 CTCs            │
                                       │      ──────────────│   excluded: <20      │
                                       │                    │   registered HIV-    │
                                       ▼                    │   positive children  │
                              ┌──────────────────┐          └──────────────────────┘
                              │   16 CTCs eligible│
                              │   for             │
                              │   randomization   │
                              └──────────────────┘
                                       │            ┌──────────────────────┐
                                       │            │   Coin flip          │
                                       │            │   randomization      │
                                       │            └──────────────────────┘
        ┌──────────────────────────────┴──────────────────────────────┐
        ▼                                                              ▼
┌──────────────────┐                                        ┌──────────────────┐
│   8 CTCs:        │                                        │   8 CTCs: Control│
│   Intervention arm│                                       │   arm            │
└──────────────────┘                                        └──────────────────┘
        │                                                              │
        ▼                                                              ▼
┌──────────────────┐                                        ┌──────────────────┐
│   570 registered │                                        │   615 registered │
│   HIV-positive   │                                        │   HIV-positive   │
│   children       │                                        │   children       │
└──────────────────┘      ┌──────────────────┐              └──────────────────┘      ┌──────────────────┐
        │                 │   173 excluded   │                      │                 │   236 excluded   │
        │   ──────────────│   based on       │                      │   ──────────────│   based on       │
        │                 │   exclusion      │                      │                 │   exclusion      │
        ▼                 │   criteria       │                      ▼                 │   criteria       │
┌──────────────────┐      └──────────────────┘              ┌──────────────────┐      └──────────────────┘
│   397 pairs of   │                                        │   379 pairs of   │
│   HIV-positive   │                                        │   HIV-positive   │
│   children and   │                                        │   children and   │
│   caregivers:    │                                        │   caregivers:    │
│   Baseline       │                                        │   Baseline       │
└──────────────────┘      ┌──────────────────┐              └──────────────────┘      ┌──────────────────┐
        │                 │   14 excluded: loss│                    │                 │   17 excluded: loss│
        │   ──────────────│   to follow-up or │                     │   ──────────────│   to follow-up or │
        │                 │   came alone to   │                     │                 │   came alone to   │
        ▼                 │   CTCs            │                      ▼                 │   CTCs            │
┌──────────────────┐      └──────────────────┘              ┌──────────────────┐      └──────────────────┘
│   383 pairs at the│                                       │   362 pairs at the│
│   final follow-up │                                       │   final follow-up │
└──────────────────┘                                        └──────────────────┘
        │                                                              │
        ▼                                                              ▼
┌──────────────────┐                                        ┌──────────────────┐
│   Analyzed: 397  │                                        │   Analyzed: 379  │
│   pairs at baseline,│                                     │   pairs at baseline,│
│   383 pairs at   │                                        │   362 pairs at   │
│   follow-up      │                                        │   follow-up      │
└──────────────────┘                                        └──────────────────┘

┌──────────────────┐                                        ┌──────────────────┐
│   2 MLPs were    │                                        │   2 MLPs were    │
│   selected from  │                                        │   selected from  │
│   each CTC =16   │                                        │   each CTC =16   │
└──────────────────┘                                        └──────────────────┘
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5.2.3 Participants

Three types of participants were included in this study. They were HIV-positive children attending HIV CTCs in the Tanga region; their caregivers; and the MLPs who care for them.

HIV-positive children: These were HIV-positive children who were registered at and attending the selected CTCs in the Tanga region during the baseline phase. A child was defined as a person aged fourteen years of age and below who was being taken care of by a caregiver. The inclusion criteria were children aged 6 months to 14 years and accompanied by his/her caregiver to the CTC. I excluded children whose caregivers refused to participate, those who lacked a confirmatory HIV test, and those without ART information from the medical data.

Caregivers of the HIV-positive children: I defined a child's caregiver as a parent or any other adult providing care for the child, accompanying him/her to the clinic (22, 173), and supervising his/her medical and nutritional care. In the intervention arm, nutrition counseling was provided to such caregivers (50). I recruited caregivers of HIV-positive children for this study because it involved children aged 6months to 14 years. Such children cannot give consent themselves or participate in the study nor can they participate in the study alone. Furthermore, the nutrition counseling conducted by the MLPs will target the caregivers of the children. I therefore recruited a similar number of caregivers as for the children. Like in the previous studies (167, 173), I used the definition of a caregiver as a child's parent, relative, guardian, or anyone else above 18 years old who takes care of the child, supervises their treatment, and accompanies the child to the CTC.

Midlevel providers (MLPs): I conveniently selected MLPs who were actively involved in the routine care and treatment of HIV-positive children attending their clinics on a monthly basis (65). I excluded all other health workers that did not fulfill the MLP criteria as per its definition. Such health workers included health promotion volunteers and non-clinician, home-based care staff.

In the current study, the selected MLPs for the intervention arm comprised 4 clinical officers, 3 assistant medical officers, 4 nurse midwives with diplomas, and 5 enrolled nurses. Similar cadres of

MLPs were available in the control group. All the CTCs in Tanga followed similar standard operating procedeures and have almost similar types and qualifications of health workers.

The selected MLPs were willing to participate in the training as well as to provide nutrition care for HIV-positive children through counseling, undernutrition treatment and follow up for the agreed duration of the study.

5.2.4 Sample size estimation

To calculate the minimum sample size for the intervention and control group, I assumed the inter-cluster coefficient (ICC) to be as low as 0.01. Also, I assumed that 8 clusters (CTCs) would be included in the intervention arm and similar number for the control arm.

I could not find any other studies based in sub Saharan Africa that estimated weight gain after implementing this type of intervention, and therefore I used a similar study conducted in China investigating children in the general population as a reference (149). In this study, an estimated mean weight gain difference between children of the intervention and control arm was 0.3kg in six months. However, it used a sample of HIV-negative population and children aged up to five years, a potential limitation to my study.

To detect the mean difference of 0.3kg weight gained in intervention group compared to the control group over a 6-month duration, at a power of 80% and 5% significant level, 24 participants per cluster will be needed. In total, a minimum sample size of 192 participants for each arm was required to produce the desired effect. To counteract the effect of loss to follow up, deaths, a number of outcome variables, and missing data, I attempted to recruit 400 HIV-positive children for the intervention arm and a similar number for control arm. Therefore, it was planned that an estimated 800 caregivers would be recruited to participate in this study, with a similar half and half distribution to the intervention group and the control group (400 in each condition).

5.2.5 Randomization process

Figure 4 shows the trial flow and randomization process. I used the CTCs as the unit of randomization. A total of 32 CTCs provide care and treatment to about 1800 HIV-positive children aged 0-14 years of age in Tanga. I excluded private CTCs, as well as CTCs with less than 20 HIV-positive children. A total of 16 CTCs in the area are public and have at least 20 HIV-positive children receiving care and/or treatment. They also represent all the districts of the region. Of the 16 CTCs, 4 are from the Tanga urban area. This is due to a high numbers of CTCs and HIV-positive patients attending them. All CTCs based in district hospitals were selected in this study because they fulfilled the selection criteria. These 16 CTCs were eligible for the randomization process: a coin toss was used to assign 8 CTCs to intervention and a similar number to the control arm. Another person who is not a member of the research team for this study conducted the randomization process.

A total of 776 pairs of HIV-positive children and their caregivers were available at baseline, of them, 397 were in the intervention arm and 379 in control arm. Two MLPs were selected from each CTC, and only those of the intervention arm received the inservice nutrition training (41). Caregivers were not informed of the nutrition training intervention for their health workers. Moreover, MLPs in the control group were not made aware of their counterparts from CTCs of intervention group and the nutrition training they received. Likewise, MLPs of the CTCs of the intervention arm were not informed about of their counterparts of the control arm.

The selected MLPs were stationed at their CTCs and these centers are located at different districts. This minimized the risk of movements and therefore contamination between CTCs assigned to intervention and control arms. Caregivers could move or travel during this trial, however, they normally receive care including adherence counseling and nutrition care at their specific centers. Therefore the chance of contamination was reduced. Moreover, analysis was designed to embrace intention to treat principle.

5.2.4 Intervention and follow-up

Three trainers conducted the nutrition training for MLPs, as explained in the study protocol (65). The team of trainers included a pediatrician, a child psychiatrist and psychologist, and a public health nutritionist. A total of 16 MLPs in the intervention arm received this training.

The 13 hours and 40 minutes nutrition training was conducted for two consecutive days in Korogwe district, Tanga. The training was organized into a total of 18 sessions, based on the standard *Guidelines for an Integrated Approach to the Nutritional Care of HIV-infected Children (6 months to 14 years)* produced by the World Health Organization (WHO) (41). The sessions included theory, practice, and role-playing (Table 18). Practical sessions included demonstrations and actual clinical management of undernutrition among HIV-positive children and were carried out in a nearby district hospital. Contents of the training were modified using the results of the formative research that preceded the current trial (49).

Table 18: Nutrition training content and session duration

Session	Content	Session duration
Session 1	Introduction	15 minutes
Session 2	Review of pre-course materials	60 minutes
Session 3	Assess growth using growth charts	40 minutes
Session 4	Measuring growth using growth charts	30 minutes
Session 5	Listening and learning counseling skills	30 minutes
Session 6	Clinical signs of malnutrition in a child	30 minutes
Session 7	Practical session 1: Assess and classify child's weight and growth	120 minutes
Session 8	Assess child's nutrition needs	30 minutes
Session 9	Decide a Nutritional Care Plan	60 minutes
Session 10	What does the child eat or drink?	45 minutes
Session 11	Who feeds the child and how does the child eat?	30 minutes
Session 12	Food security	30 minutes
Session 13	Building confidence and support skills	30 minutes
Session 14	Practical Session 2: Assessing and classifying a child's nutritional status	120 minutes
Session 15	Exercise, risk factors and referral	30 minutes
Session 16	The HIV-infected child with special needs	60 minutes
Session 17	Children on antiretroviral treatment	30 minutes
Session 18	Conclusion and competencies	30 minutes
Total training duration 13 hours 40 minutes		

The added items based on results and observation made during the formative research included:

1. Local determinants of undernutrition especially on feeding practices: The formative research found a high magnitude of poor feeding practices among HIV-positive children in Tanga, Tanzania. Children were fed at a lower than WHO recommended frequency for HIV-positive children and majority had low dietary diversity. The formative research also found misconceptions and poor nutrition knowledge of caregivers and their MLPs on feeding practices. Such evidence pointed to necessity of this training. The WHO guidelines suggested

tailor-made approach and therefore, such examples were inserted in sessions 7-11 of the current nutrition training.

2. Local foods available and how best to use them in nutrition care plan: Localy available and affordable foods vary across different geographical areas and context. In Tanga, locally available foods were enumerated and during the formative research. They were discussed during the preparation phase of this training and examples of right mix for diversity was included in the nutrition training. These items were inserted in sessions 8-10

3. What constitute a 'good food' for children: In formative research caregivers and even MLPs had different views of what constitute 'a good or nutritious food'. Majority of caregivers had heard about how important it is to mix foods. However, they mixed different types of cerials withought other food groups. They thought of a good food as the one with meat or high priced fish that was not affordable to poor people, and fruits or vegetables are not food. Vegetables are foods of poor people and not the wealthier strata. Such misconceptions of 'good food' were addressed in session 9.

4. How to deal with misconceptions as identified in formative research: Health workers were trained how to deal respectifully with known and identified misconception without offending the caregivers. These methods and statements to be used were inserted in sessions 9-10.

5. Addressing selective food insecurity: Food insecurity was rampant in Tanga, especially among households of HIV-positive populations. The known knowledge that food was universally available in Tanga was found to be untrue in the formative research. Because of the findings of that research, session 12 was dedicated on how best is to deal with selective food insecurity and use the existing resources wisely.

The trained MLPs provided tailored nutrition counseling and management of undernutrition to HIV-positive children and their caregivers attending monthly visits to their CTCs. Such nutrition care and treatment were conducted within the normal schedules of participants as they attend CTCs to receive

their ART or care. In addition to the adherence counseling, nutrition counseling and care was provided separately for each participant.

Counseling and undernutrition management duration varied from patient to another depending on their condition, level of understanding, and patients' burden in a typical clinic day. Under a normal condition, such counseling took 30 minutes in average. This included time for assessing nutritional needs, making a nutrition care plan, and providing counseling based on the locally available foods and needed amounts thereof. MLPs also assessed children's nutritional statuses, and managed undernutrition and other ailments associated with undernutrition. They followed up on observed improvements or deteriorations in feeding practices, weight, and height.

MLPs of the control arm, meanwhile, received a one-day re-orientation in pediatric HIV-care. Finally, they were oriented on the questionnaire, data collection process, and ethical issues involved in the current research. Through the six-month follow up, they continued with their standard care for HIV-positive children (22). This included clinical HIV-staging, adherence counseling, provision of ART, and management of opportunistic infections, similar to MLPs of the intervention arm.

Both intervention and control arms were followed for a period of six months. Each time a child and his/her caregivers attended the CTCs, nutrition evaluation and counseling or management of undernutrition was conducted in the intervention arm. For both arms, I measured feeding practices, nutrition status, and other health-related parameters monthly and at the end of the trial and compared them with those observed at baseline. However, the caregivers' attendance to the CTC varied between months, especially for the control group. The variation was because of the tendency of older children to attend CTCs by themselves to refill their ART. For this research, I could only interview caregivers. Therefore, if a child came alone, s/he was considered a loss to follow up or missing data. Efforts were done more for the intervention arm as the nutrition counseling targeted caregivers.

5.2.5 Measurements

Nutrition status: The outcome variables in this trial were anthropometry (weight, height, and BMI) and nutrition status of HIV-positive children. First, weight and height were measured for all recruited children. Weight was measured using the hanging Salter scale® (UK) with minimal clothing for young children, and Salter digital scale® (Brooklyn, USA) for older children who could stand (201). Height was measured using a Seka® measuring rod for the 24 months and older children (201), and using a marked measuring board in a recumbent position for younger children (202).

Weight and height were converted into the anthropometric indices using the 2006 WHO child growth standards (203). The *STATA igrowup* package was used to convert such measurements into height-for-age z-scores (HAZ-scores), weight-for-age z-scores (WAZ-scores), body mass index-for-age z-scores (BMIZ-scores), and weight-for-height z-scores (WHZ-scores). According to the 2006 WHO child growth standards recommendations, HAZ was measured for all children; WAZ was measured for children aged 6 months to 120 months, WHZ for children aged 6 months to 60 months, and BMIZ for all children (172, 204). Nutrition status was generated through a cut-off of Z-score < -2SD for all anthropometric indices. WHZ and BMIZ indicate wasting and thinness respectively if the child has z-scores of less than -2SD. Z-scores of -2SD for HAZ and WAZ indicates stunting and underweight respectively.

Feeding practices: Feeding practices were taken as outcome variables and independent variables in a different circumstance. It was an outcome variable when examining the efficacy of nutrition training on it. Feeding practices bacame independent variable when I examined the effectiveness of nutrition training on anthropometry or nutrition status through its changes.

I measured feeding practices using feeding frequency and dietary diversity scores. Like in previous studies (22, 49, 173), I asked the caregivers of HIV-positive children about the times they had fed their children in the previous 24 hours. I also measured dietary diversity by asking caregivers to provide a

list of foods they had fed to their children in the previous 24 hours. I made a dietary diversity score (DDS) based on the list of common foods recalled.

Like in the previous studies in Tanzania (49, 65), twelve items in the common foods consumed in Tanzania was used as a list for the DDS. The list of the food items included the following foods: cereal based foods such as bread, maize based 'ugali', maize based porridge, millet, sorghum, and rice; yellow or orange tubers such as pumpkin, carrot; white tubers such as sweet potatoes, irish potato, white sweet potato, cassava, cocoyam, white yam; leafy vegetables such as marath, cassava green, pumpikin green, cabbage, and spinach; yellow or red fruits such as papaya or mango; any other vegetable or fruits; red meat such as muton or beef; poultry and other white meat; fish and other marine foods; eggs; legume foods such as beans, groundnuts, sunflower; diery products such as cheese, milk, and yourghut; and other foods from oil/fat such as margarine, ghee, and butter. Feeding frequency and dietary diversity were treated as continuous variables.

Nutrition knowledge: I measured nutrition knowledge of MLPs of the intervention arm using a standard questionnaire included in the training materials associated with the nutrition training (41). First, I measured the general knowledge on health- and nutrition-related aspects using scores of the 40 items in all eight sections of the nutrition-training questionnaire. Second, I measured specific aspects of knowledge as follows: three sections (12 items) on general HIV knowledge; one section (4 items) on food preparation knowledge; two sections (8 items) on child feeding practices knowledge; and two sections (8 items) on nutrition counseling skills knowledge. One point was awarded when a participant responded correctly to the given item and zero for a wrong response. For the general knowledge sections, the total scores ranged from 0 to 40. On specific aspects, scores for general HIV knowledge ranged from 0 to 12. For knowledge on food preparation hygiene, scores ranged from 0 to 4. For feeding practices and counseling skills, total scores ranged from 0 to 8 for each.

MLPs of the control group were not evaluated for their nutrition knowledge to avoid contamination before the trial. This is because, any misconception would have to be cleared and in practical sense,

also for ethical concerns. This would have called for some types of nutrition training and therefore contaminate the control group.

Household food insecurity: I measured household food insecurity using the Household Food Insecurity Access Scale (HFIAS) (176). This is because food insecurity was associated with both acute and chronic forms of undernutrition among ART-treated HIV-positive children in Tanzania (167). This scale has nine items on food access experience. Options are ranked from 0 = 'no', 1 ='rarely', 2 = 'sometimes', and 3 = 'often'. Score ranges from 0 to 27; higher scores reflect more severe food insecurity. This scale is a unidimensional: measuring food insecurity, with the higher the score the higher the household food insecurity. The scale can continuously measure food insecurity, or it can be used categorically to identify food secure or insecure households. The recall duration is shorter compared to other scales; HFIAS uses a 30 days recalling period. It has been used among HIV-positive population in Kenya and Uganda (8, 177-181). For the current study, the mean score was 8.50, Standard Deviation: 8.34, Skewness: 0.76. In the histogram, it showed floor effect, and was skewed to the right.

HIV clinical stage: Advanced HIV clinical stage was associated with chronic undernutrition in Tanzania (167, 173). Like in the previous studies, I used WHO clinical staging to determine the disease progression. The four-stage classification uses both medical history and physical examination to classify the disease progression. The first two clinical HIV stages are regarded as "early stages", whereas clinical HIV stages 3 and 4 are regarded as "advanced stages" (182). In this study, I extracted the highest reached WHO clinical stage from the medical file of each child attending the CTC. The CTC staff updated such information on a routine basis with each CTC visit.

Opportunistic infections: I also assessed the presentation of any common opportunistic infections (OIs). Previous studies showed an association of OIs with undernutrition among children living with HIV in Tanzania (137, 167), and other countries in sub-Saharan Africa (3, 16, 205). Such OIs include diarrhea, malaria, TB, upper respiratory tract infections, and oral/esophageal candidiasis. Diarrhea was

defined as the presence of three or more watery stools during the previous 24 hours (206). Malaria was defined as a typical febrile illness characterized by fever, chills and sweating, and evidenced by parasitological examination (183). I assessed other opportunistic infections based on a medical history and medical records.

Socio economic position: I assessed economic status using a weighted wealth index. The index incorporates household durable assets ownership, such as owning a paraffin lamp, television, radio, telephone, flat iron, refrigerator, bicycle, motor car, farm and having electricity; housing and dwelling characteristics including main floor materials, house ownership, fuel for lighting and cooking, type of toilet, source of water, feeding characteristics, and household food satisfaction (175), (165). I constructed dichotomous variables for these items and carry out factor analysis using principle component analysis (PCA) to reduce such variables into ones that will load as factor 1, which describe the socio-economic position of the study population. I used tetrachoric command in STATA to compute estimates of tetrachoric correlations. This was because of the dichotomous variables created earlier for each item in the wealth index question. I used factor loadings as item weights, and summed them to yield the wealth index for each household (185), (186), (187). This was treated as a continuous variable and used as such in regression analyses. I further divided the total weighted wealth index score into two to designate levels of economic status as high and low divided at 50th percentile.

Other socio demographic data: I adopted other socio-demographic variables pertaining to children and their caregivers from the women and household questionnaires of the Tanzania Demographic and Health Survey (TDHS) (175), (165). Population surveys in Tanzania have already tested and use these variables both in 2005 and 2010. Such variables will include education level, orphanhood, religion and marital status.

Education level was made into a categorical variable as none (if a caregiver did not experience any formal schooling), primary level (if a caregiver had a primary level education) and above primary if the caregiver had completed primary school and proceeded to secondary school or above. Age of a

child was taken in months. Parental status was designated as non-orphaned or orphan if a child had lost one or both parents.

5.2.6 Data collection

Like in my previous studies in Tanzania (22, 49, 173), I used a standard Swahili questionnaire that was developed in English, translated into Swahili, and then back-translated into English by different researchers to ensure retention of meaning for all variables. Data were collected at baseline, at each CTC visit, and at 6-month follow-up. I used standard pre-tested questionnaires in Swahili for both baseline and follow-up phases. Trained research assistants, who were also used in the formative research phase (49), received training on the questionnaire contents, ethics, and anthropometric measurement methods. I conducted face-to-face interviews in Swahili with the caregivers of HIV-positive children, measured children's weight and height, and retrieved medical data from their records (65). Self-administered questionnaires were used to assess the nutrition knowledge of MLPs in the intervention arm before and after the nutrition training.

5.2.7 Analysis

I analyzed data using both descriptive methods and regression analyses. I used paired sample t-tests to compare mean nutrition knowledge and its related aspects for MLPs before and after the training. I conducted chi-square tests and student t-tests to examine differences in characteristics between intervention and control arms at baseline. Similar tests were used to compare feeding practices (feeding frequency and dietary diversity), anthropometry (weight and height), and nutrition status (underweight, wasting, stunting, and thinnes) of children in intervention and control arms both at baseline and at 6-month follow-up.

To test my hypotheses, I conducted instrumental variable random effects regression (207), with panel data. These analyses used panel data to include only the participants who had data at baseline as well as at the final follow-up. The two-stage regression first examined whether the nutrition training improved feeding practices (i.e., feeding frequency and dietary diversity). At the second stage, the

random effects regressions included feeding practices as independent variables and examined changes in anthropometry (weight, height, and BMI) in three different models, while controlling for other potential confounders or differences between and within groups. Similar analysis was repeated for nutrition status with three models including for underweight, stunting, and thinness. A wasting-model was not built because of a small sample of children underfives.

The interaction term of intervention and follow-up was the instrument in this instrument variable random effect model regression. Feeding practices i.e. feeding frequency and dietary diversity was the instrument variable. In this case, feeding frequency or dietary diversity was intrumented by the interaction term of intervention and follow-up. I repeated the above regression in three models (weight, height, and BMI) to examine the efficacy of the intervention on dietary diversity in the first of the two-stage regression. For the second stage, I examined the efficacy of the intervention on the changes of weight, height, and BMI as the outcome variable. Similar analyses were conducted for another three models (underweight, stunting, and thinness), to assess the efficacy of the intervention on nutrition status through changes of dietary diversity.

I calculated the effect size of this intervention using Number Needed to Treat (NNT). NNT was calculated while accounting for cluster effects and confounding variables based on the odds ratio (OR) using the formula from a separate research with similar study design (208) as follows:

$$NNT= [(1-(PEER (1-OR))] /[(1-PEER) PEER (1-OR)]$$

Odd ratio was calculated using logistic regression models with random effects for clusters and adjusted for age, sex, caregiver's education, wealth index, and food insecurity. PEER is the patient expected event rate estimated using the event rate of the control group. I used the intention-to-treat principle to analyze the data and set the statistical significance at $p<0.05$. All analyses were conducted using STATA version 12 (StataCorp, College Station, Texas, USA).

5.2.8 Ethical considerations

I obtained written consent from the training participants (MLPs) and caregivers of HIV-positive children before data collection. I explained the process of data collection and that their participation was voluntary and there were no implications for their refusal to participate.

Only MLPs of the intervention arm participated in the intervention and training. Only these MLPs gave consent as I asked them questions about their nutrition knowledge before and after the training. They were not made aware of their control arm counterparts. For MLPs of the control arm, nutrition training was not conducted at this time and therefore, consents were applied for only caregivers they attended. They were not made aware of the intervention arm in order not to introduce contamination through movement and communication before the effectiveness of this intervention was determined.

This study was approved by the Research Ethics Committee of the University of Tokyo, and the Expedited Review Sub-committee of the Senate Research and Publication Directorate of the Muhimbili University of Health and Allied Sciences.

5.3 Results

5.3.1 General characteristics of intervention and control arms

Figure 5 shows participants recruited and available for final analysis. Data from 776 pairs of HIV-positive children and their caregivers were available for analysis at baseline. Among them, 397 pairs belonged to the CTCs of the intervention arm. At the final follow-up, data from 745 pairs were available. Among them, 383 pairs belonged to the intervention arm.

Table 19 shows the general characteristics of participants and compares intervention and control arms. A higher proportion of HIV-positive children (59.4% for the intervention and 64.5% for the control arm) had lost one or both parents. A high proportion of such children were on ART (86.4% in the intervention vs. 88.9% in the control arm). The mean ART duration for the intervention arm was 36.9 months compared to 33.5 months among those in the control arm. However, 72.8% of the HIV-positive children in the intervention arm and 72.2% of those in the control arm had advanced HIV clinical stages.

Table 19: Descriptive characteristics of intervention and control arms

Variable	Total	Intervention			Control			P
		n	% (mean)	SD	n	% (mean)	SD	
Age (months)*	776	397	(103.6)	43.5	379	(98.2)	45.1	0.097
Sex**								
Male	372	199	50.3		173	45.7		0.199
Female	403	197	49.7		206	54.3		
Orphan-hood**								
Both parents alive	280	154	40.6		126	35.5		0.388
Only mother alive	166	82	21.6		84	23.7		
Only father alive	117	54	14.3		63	17.7		
Both parents dead	171	89	23.5		82	23.1		
HIV-clinical stage**								
Stage I	52	23	5.9		29	8.0		0.054
Stage II	155	83	21.3		72	19.8		
Stage III	463	230	59.1		233	64.2		
Stage IV	82	53	13.7		29	8.0		
On ART**								
No	96	54	13.6		42	11.1		0.293
Yes	679	343	86.4		336	88.9		
ART duration*								
Mean months	677	357	(36.9)	27.8	320	(33.5)	27.5	0.108
Caregiver**								
Mother	352	179	45.1		173	45.7		0.876
Other	424	218	54.9		206	54.3		
Education level (caregiver)**								
Not formal	208	113	28.5		95	25.1		0.074
Primary	497	241	60.7		256	67.7		
Secondary &above	70	43	10.8		27	7.2		
Wealth index**								
Low	388	193	48.6		195	51.5		0.430
High	388	204	51.4		184	448.5		
Food security (HFIAS)**								
Food-secure	230	126	31.7		104	27.4		0.190
Food-insecure	546	271	68.3		275	72.6		

* t-test; ** Chi-square test

5.3.2 Effectiveness of nutrition training in improving nutrition knowledge

The knowledge score of MLPs improved after the training compared to the pre-training test (37.1 vs. 23.5, p < 0.001). Moreover, all four main aspects of knowledge scores tested in this study improved significantly at the post-training test compared to the pre-training test session **(Table 20)**. There was no ceiling or floor effect for nutrition knowledge scale at baseline. However, because of the training, all four aspects of knowledge measured assumed the ceiling effect. This was expected as the knowledge test was conducted immediately post training.

Table 20: MLP's nutritional knowledge before and after receiving nutrition training for HIV-positive children in the intervention arm

Aspect of knowledge	N	Mean	SD	P*
Total knowledge score				
Pre-training	16	23.5	6.5	<0.001
Post-training	16	37.1	3.1	
Pediatric HIV				
Pre-training	16	9.8	0.9	<0.001
Post-training	16	14.5	0.2	
Food preparation hygiene				
Pre-training	16	2.9	1.0	<0.001
Post-training	16	4.6	1.0	
Feeding practices				
Pre-training	16	4.4	2.1	<0.001
Post-training	16	9.3	0.9	
Nutrition counseling				
Pre-training	16	6.4	1.6	<0.001
Post-training	16	8.8	1.7	

* P-value for the paired sample t-test

5.3.3 Changes in feeding practices following the intervention

HIV-positive children in the intervention arm had a slightly higher mean feeding frequency at baseline compared to those of the control arm (2.8 vs. 2.6, p = 0.041) (**Table 21**). However, a significant increase in feeding frequency was observed in the intervention arm compared to the control arm at the final follow-up (4.4 vs. 3.1, p < 0.001).

HIV-positive children in both arms had low feeding frequency compared to the recommended value by the WHO at baseline. For example, only 12 children of the intervention arm (3.1%) and 5 children of the control arm (1.3%) had a feeding frequency of five times or above per day at baseline. However, children of the intervention arm showed a significant improvement in their feeding frequency compared to their counterparts at the follow-up stage. For example, 172 HIV-positive children in the intervention arm (44.9%) had a feeding frequency of five times or more compared to only 34 children of the control arm (9.4%), p<0.001. Especially in the intervention arm, a significant 41.8% of children had improved their feeding frequency to the WHO's recommended level of feeding frequency compared to only 8.1% point increase for the control arm. This translates to a 38.7% improvement of children exposed to the intervention compared to only 6.8% designated as the control group. The Number Needed to Treat to change one child's feeding frequency was 12.1.

Similarly, dietary diversity improved significantly among HIV-positive children in the intervention arm compared to those of the control arm. The mean dietary diversity of children at intervention arm was 2.8 foods at baseline while those of the control arm; the mean dietary diversity was 2.9 foods (p=0.061). These values improved for both arm, however, a significant increase was observed among the children of the intervention arm compared to those of the control arm (4.3 vs. 3.4, p<0.001)

In real terms, about 276 children of the intervention arm (69.5%) and 259 of the control arm (68.3%) had a dietary diversity score of three foods per day or more. Following the nutrition intervention and a six-month follow-up in the intervention arm, a total of 379 children of the intervention arm (99.0%)

and 336 of control arm (92.8%) reached the dietary diversity score of three foods or more per day and the difference between them was statistically significant (p<0.001). NNT was 1.4.

5.3.4 Changes in anthropometry following the intervention

Height and weight were not significantly different at baseline between the HIV-positive children attending CTC of intervention and control arms **(Table 21)**. However, following the intervention and a six-month follow-up, a mean increase in weight of about 300g was observed for the intervention arm compared to the baseline period. Meanwhile, at the similar follow up period, a 400g decrease was observed for the mean weight of children of the control arm at six-month follow-up period compared to the baseline period. At the follow-up period, the difference between weighs of both arms was statistically significant (22.0 kg vs. 20.5 kg, p = 0.003).

5.3.5 Changes in anthropometric indices and nutrition status following the intervention

Changes in weight led to improvement in weight-related anthropometric indices over the 6-months follow-up **(Table 21).** For example, at baseline mean weight-for-age-Z (WAZ) scores for the intervention arm and control arm were -1.5 and -1.6 respectively, p=0.229. The mean WAZ score for intervention arm improved significantly at the six-month follow-up and was statistically significant different compared to that of the control arm (-1.1 vs -1.9, p<0.001). Similar trend was observed for the weight-for-height and BMI-for-age z scores, but not for the Height-for-age z score.

As a result of changes of weight and related anthropometric indices, nutrition status resulted from weight also improved significantly for the intervention arm. For example, 79 HIV-positive children of the intervention arm (33.2%) had underweight at baseline. Similarly 105 (42.2%) of their counterparts had underweight at baseline in the control arm. As the result of this intervention, only 55 children of the intervention arm (22.6%) remained to have underweight compared with 104 (45.6%) of the control arm after six months of follow up.

This intervention has led into a decrease in child underweight status from 33.2% at baseline to 22.6% at 6-month follow-up for the intervention arm leading to a significant difference with those of control

group (p < 0.001). A significant 10.6% of HIV-positive children with clinical underweight status moved from underweight status to normal weight for their age. This similar change was not observed among children of the control group. The NNT to change underweight for one child was 3.9.

A positive change in the weight gain (300g) also led to a decrease in proportion of children categorized as thin (BMIZ<-2SD). A decrease of such magnitudes of children deemed thin was from 14.9% at baseline to 12.0% at a six-month follow up, and this was significantly different from children of the control group at 6-months (p = 0.004). At baseline 59 (14.9%) HIV-positive children of the intervention arm and 69 (18.2%) of the control arm were categorized as thin. At six month follow up, only 46 (12.0%) of those at intervention arm remained at this undernutrition status category. On the contrary, 71 (19.6%) of their counterparts were diagnosed as thin at the six-month follow-up. This means that, 2.9% of HIV-positive children who were regarded as clinically thin improved because of this intervention.

Table 21: Changes of feeding practices, anthropometry, and nutrition status between intervention and control arms

Variable	Total	Intervention arm			Control arm			P
		n	Mean (%)	SD	n	Mean (%)	SD	
Total feeding frequency **								
Baseline	776	397	2.8	0.8	379	2.6	0.6	0.041
Month 6	745	383	4.4	0.7	362	3.1	0.8	<0.001
Feeding frequency above 5 *								
Baseline	776	12	(3.1)		5	(1.3)		0.105
Month 6	745	172	(44.9)		34	(9.4)		<0.001
Total dietary diversity score **								
Baseline	776	397	2.8	0.7	379	2.9	0.9	0.061
Month 6	745	383	4.3	0.8	362	3.4	0.7	<0.001
Dietary diversity atleast 3/day *								
Baseline	776	276	(69.5)		259	(68.3)		0.772
Month 6	745	379	(99.0)		336	(92.8)		<0.001
Height (cm) **								
Baseline	776	397	115.7	20.0	379	114.0	20.8	0.240
Month 6	747	383	113.5	21.9	362	113.8	19.2	0.794
Weight (kg) **								
Baseline	776	337	21.7	7.4	379	20.9	7.9	0.134
Month 6	745	383	22.0	7.1	362	20.5	7.4	0.003
Weight-for-age z-scores **								
Baseline	486	238	-1.5	1.3	248	-1.6	1.5	0.229
Month 6	472	243	-1.1	1.3	228	-1.9	1.3	<0.001
Height-for-age z-scores **								
Baseline	774	396	-2.4	1.6	378	-2.2	2.0	0.107
Month 6	745	383	-2.7	1.8	362	-2.5	1.8	0.127
Weight-for-height z-scores **								
Baseline	160	80	0.4	1.8	80	-0.6	1.9	0.001
Month 6	141	72	1.6	2.3	69	-0.4	1.3	<0.001
BMI-for-age z-scores **								
Baseline	774	396	-0.5	1.6	378	-0.8	1.8	0.011
Month 6	745	383	0.2	2.1	362	-0.9	1.6	<0.001
Underweight (age 6-120months) *								
Baseline	487	79	(33.2)		105	(42.2)		0.041
Month 6	471	55	(22.6)		104	(45.6)		<0.001

Stunting (age 6months-14 years) *

Baseline	776	253	(63.7)	216	(57.0)	0.055
Month 6	745	263	(68.7)	231	(63.8)	0.161

Thinness (age 6months-14 years) *

Baseline	776	59	(14.9)	69	(18.2)	0.210
Month 6	745	46	(12.0)	71	(19.6)	0.004

** t-test; * Chi-square test;

Number Needed to Treat (NNT)

Feeding frequency above 5/day = 12.1; Dietary diversity at least 3/day = 1.4;
Underweight = 3.9; Thinness =7.0; Stunting = 40.7

5.3.6 Effectiveness of the intervention in improving anthropometry and nutrition status through improving feeding frequency

Table 22 shows the results of the instrumental variable random effects regression. Three models were constructed for a two-stage regression. The models were for Weight (kg), Height (cm), and BMI (kg/m^2). In the first stage regression, feeding frequency increased significantly in the intervention arm and during the six-month follow-up following the nutrition training intervention compared with the baseline in all the three models after adjusting for age and sex of the child, education level of caregiver, household wealth index, and food insecurity as follows: Weight-model: $\beta = 1.17$, $p < 0.001$; Height-model: $\beta = 1.17$, $p < 0.001$; and BMI-model: $\beta = 1.18$, $p < 0.001$). After adjusting for those important confounders and covariates, feeding frequency generally improved at the final follow-up compared to the baseline (Weight-model: $\beta = 0.42$, $p < 0.001$; Height-model: $\beta = 0.42$, $p < 0.001$; and BMI-model: $\beta = 0.42$, $p < 0.001$).

The second stage in the analysis was conducted to undertake an instrumental variable regression to examine the independent association of changes in feeding frequency with anthropometry **(Table 22)**. An increase in each unit of feeding frequency was associated with a 1.27 kg increase in the child weight ($p < 0.001$) and a 1.19 kg/m^2 increase in the BMI ($p < 0.001$). However, the association of the feeding frequency and child height was not statistically significant ($\beta = -0.10$, $p = 0.830$). There was no significant association between group assignment and anthropometry at baseline. However, children assigned to the control arm had poorer anthropometry at the six-month follow-up.

A month increase in the age of a child was associated with a 0.12kg increase in weight ($p < 0.001$); a 0.30cm increase in height ($p < 0.001$); but not a significant change in BMI of a child ($p = 0.055$). An increase in caregiver's education level, meanwhile, was associated with a 0.50kg increase in child's weight ($p = 0.015$) and a 1.51cm increase in child's height ($p=0.002$), but not significant to improve BMI.

Table 22: Effect of the intervention on anthropometry through changes in feeding frequency: Instrument variable random effects regression

First stage: Changes in feeding frequency at 6 months post-intervention

Variable	Weight (kg)-model			Height (cm)-model			BMI-model		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Intervention*follow-up	1.17	1.07, 1.28	<0.001	1.17	1.07, 1.28	<0.001	1.18	1.07, 1.29	<0.001
Intervention	0.26	-0.54, 1.06	0.528	0.29	-0.60, 1.18	0.519	0.14	-0.22, 0.49	0.453
Follow-up	0.42	0.34, 0.50	<0.001	0.42	0.34, 0.50	<0.001	0.42	0.34, 0.49	<0.001
Age	-0.01	-0.01, 0.01	0.339	-0.01	-0.01, 0.01	0.339	-0.01	-0.01, 0.01	0.326
Sex	0.26	0.10, 0.44	0.005	0.26	0.08, 0.45	0.005	0.21	0.04, 0.38	0.014
Caregiver's education	-0.02	-0.01, 0.07	0.709	-0.02	-0.11, 0.11	0.707	-0.01	-0.10, 0.08	0.078
Wealth index	0.04	-0.01, 0.08	0.074	0.04	-0.01, 0.08	0.074	0.04	-0.01, 0.01	0.150
Food insecurity	0.01	-0.01, 0.01	0.102	0.01	-0.01, 0.01	0.099	0.01	-0.02, 0.01	0.754

Second stage: random effects regression: changes in anthropometry as a result of changes in feeding frequency

Variable	Weight (kg)			Height (cm)			BMI		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Feeding frequency	1.27	0.87, 1.66	<0.001	-0.10	-1.04, 0.84	0.830	1.19	0.91, 1.47	<0.001
Intervention	-0.31	-4.80, 2.19	0.464	-4.11	-13.41, 5.18	0.386	0.06	-1.04, 1.17	0.908
Follow-up	-1.25	-1.71, -0.78	<0.001	-1.10	-2.21, 0.02	0.053	-0.69	-1.02, -0.36	<0.001
Age	0.12	0.11, 0.13	<0.001	0.30	0.27, 0.33	<0.001	0.01	-0.01, 0.01	0.055
Sex	-1.90	-2.71, -1.08	<0.001	-1.01	-2.98, 0.95	0.311	-0.96	-1.48, -0.43	<0.001
Caregiver's education	0.50	0.10, 0.89	0.015	1.51	0.56, 2.47	0.002	-0.03	-0.30, 0.25	0.842
Wealth index	0.04	-0.14, 0.22	0.665	0.35	-0.08, 0.79	0.114	-0.06	-0.18, 0.07	0.385
Food insecurity	-0.02	-0.06, 0.01	0.169	-0.07	-0.16, 0.01	0.076	0.01	-0.02, 0.25	0.901

Weight model: n (pairs)=740; Model fit (R^2) = 65.1%; Height model n (pairs)=740; R^2 = 70.8%; BMI model: n (pairs)=740; R^2 = 2%

Intervention*follow-up= interaction term between intervention and follow-up

Intervention: subjects at the intervention compared to control arm

Follow-up: subjects at the follow-up compared to the baseline

Table 23 shows the results of the instrumental variable random effects regression on the nutrition status as the outcome variables. Similar to the anthropometry, three models were also contructed for a two-stage regression. The models were for underweight (WAZ<-2SD), stunting (HAZ<-2SD), and thinness (BMIZ<-2SD). In the first stage regression, similar trends were observed. Following the nutrition training intervention, feeding frequency increased significantly in the intervention arm and at the six-month final follow-up compared with the baseline in all the three models as follows: underweight-model: β = 1.15, p < 0.001; stunting-model: β = 1.17, p < 0.001; and thinness-model: β = 1.19, p < 0.001). After adjusting for important confounders and covariates, feeding frequency generally improved at the final follow-up compared to the baseline (underweight-model: β = 0.39, p < 0.001; stunting-model: β = 0.41, p < 0.001; and thinness-model: β = 0.41, p < 0.001).

The second stage in the analysis was also conducted to undertake an instrumental variable regression to examine associations of feeding frequency and nutrition status (**Table 23**). An increase in each unit of feeding frequency was associated with a 0.15-unit decrease in the child underweight (p < 0.001). However, the association with the feeding frequency and child height was not statistical significant (β = -0.10, p = 0.874). Being in the intervention or control arm was not associated with changes in nutrition statuses at baseline. However, being in the control arm was associated with poorer nutritional status at the follow-up stage. For example, a change in feeding frequency from baseline to the final follow-up was associated with a significant increase in underweight (β = 0.12, p = 0.012), but not with significant change in the stunting (β = 0.05, p = 0.052) or thinness (p=0.541).

A month increase in the age of a child was associated with a 0.01-unit increase in underweight (p = 0.018), a 0.01-unit increase in stunting (p < 0.001), and a 0.01-unit increase in thinness (p < 0.001). A unit increase in household food insecurity score was associated with 0.01-unit increase in child stunting (p = 0.007).

Table 23: Effect of the intervention on nutrition status through changes in feeding frequency: Instrumental variable random effects regression

First stage: Changes in feeding frequency at 6 months post-intervention

Variable	Underweight-model			Stunting-model			Thinness-model		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Intervention*follow-up	1.15	0.98, 1.31	<0.001	1.17	1.07, 1.28	<0.001	1.19	1.08, 1.30	<0.001
Intervention	0.12	-0.03, 0.26	0.129	0.27	-0.54, 1.05	0.529	0.12	-0.07, 0.31	0.226
Follow-up	0.39	0.27, 0.51	<0.001	0.41	0.34, 0.49	<0.001	0.41	0.33, 0.49	<0.001
Age	-0.01	-0.01, 0.01	0.849	-0.01	-0.01, 0.01	0.339	-0.01	-0.01, 0.01	0.225
Sex	-0.06	-0.18, 0.06	0.333	0.26	0.08, 0.45	0.005	0.11	-0.02, 0.25	0.111
Caregiver's education	0.02	-0.08, 0.12	0.671	-0.02	-0.11, 0.07	0.709	-0.01	-0.09, 0.08	0.918
Wealth index	0.04	-0.01, 0.09	0.100	0.04	-0.01, 0.08	0.074	0.01	-0.01, 0.08	0.079
Food insecurity	0.01	-0.01, 0.01	0.892	0.01	-0.01, 0.01	0.102	-0.03	-0.01, 0.01	0.380

Second stage: random effects regression: changes in nutrition status as a result of changes in feeding frequency

Variable	Underweight-model			Stunting-model			Thinness-model		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Feeding frequency	-0.15	-0.24, -0.07	<0.001	-0.01	-0.05, 0.04	0.874	-0.04	-0.08, 0.01	0.059
Intervention	-0.07	-0.16, 0.02	0.133	0.35	-0.06, 0.75	0.097	-0.03	-0.11, 0.05	0.402
Follow-up	0.12	0.03, 0.21	0.012	0.05	-0.01, 0.11	0.052	0.01	-0.03, 0.06	0.541
Age	0.01	0.01, 0.01	0.018	0.01	0.01, 0.01	<0.001	0.01	0.01, 0.01	<0.001
Sex	-0.02	-0.09, 0.05	0.575	-0.01	-0.10, 0.10	0.979	-0.01	-0.06, 0.05	0.832
Caregiver's education	-0.01	-0.06, 0.05	0.917	-0.03	-0.07, 0.02	0.245	-0.02	-0.06, 0.01	0.204
Wealth index	-0.02	-0.05, 0.01	0.083	0.01	-0.01, 0.04	0.173	-0.01	-0.02, 0.01	0.691
Food insecurity	0.01	-0.01, 0.01	0.514	0.01	0.01, 0.01	0.007	-0.01	-0.01, 0.01	0.154

Underweight model: n (pairs)=512; Model fit (R^2) = 7.8%; Stunting model n (pairs)=740; R^2 = 1.0%; Thinness model: n (pairs)=740; R^2 = 3.1%

Intervention*follow-up= interaction term between intervention and follow-up

Intervention: subjects at the intervention compared to control arm

Follow-up: subjects at the follow-up compared to the baseline

5.3.7 Effectiveness of the intervention in improving anthropometry and nutrition status through the improvement of dietary diversity

Table 24 shows the results of the instrumental variable random effects regression with anthropometry as the outcome variable of interest. Three models were also created as follows: Weight (kg)-model, Height (cm)-model, and BMI (kg/m^2)-model. A two-stage regression analysis also was conducted using panel data to assess changes in the dietary diversity and its association with changes of anthropometry.

In the first stage, following the nutrition training intervention, dietary diversity score improved significantly in the intervention arm and at the final follow-up in all three models after adjusting for child's age, sex, caregiver's education level, household wealth index, and food insecurity (Weight-model: $\beta = 1.12$, $p < 0.001$; Height-model: $\beta = 1.10$, $p < 0.001$; and BMI-model: $\beta = 1.10$, $p < 0.001$). Dietary diversity score improved from baseline to the follow-up period (Weight-model: $\beta = 0.48$, $p < 0.001$; Height-model: $\beta = 0.46$, $p < 0.001$; and BMI-model: $\beta = 0.46$, $p < 0.001$). A unit increase in food insecurity score was associated with a 0.01-unit decrease in dietary diversity in the Weight-model ($p = 0.003$), Height-model ($p<0.001$), and BMI-model ($p<0.001$).

In the instrumental variable regression stage, an increase in each unit of dietary diversity was associated with a 1.39kg increase in the child weight ($p < 0.001$) and a 0.01kg/m^2 increase in the child's BMI ($p < 0.001$). However, the association with the height was not statistically significant ($\beta = -0.01$, $p = 0.984$).

Table 24: Effect of the intervention on anthropometry through changes in dietary diversity: Instrumental variable random effects regression

Effect of the First stage: Changes in dietary diversity at 6 months post-intervention

Variable	Weight (kg)-model			Height (cm)-model			BMI-model		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Intervention*follow-up	1.12	0.96, 1.28	<0.001	1.10	0.98, 1.23	<0.001	1.10	0.96, 1.23	<0.001
Intervention	-0.08	-0.25, 0.08	0.331	-0.07	-0.22, 0.07	0.326	-0.07	-0.20, 0.05	0.262
Follow-up	0.48	0.36, 0.60	<0.001	0.46	0.37, 0.55	<0.001	0.46	0.36, 0.56	<0.001
Age	0.01	-0.01, 0.01	0.903	-0.01	-0.01, 0.01	0.544	-0.01	-0.01, 0.01	0.380
Sex	-0.08	-0.21, 0.06	0.259	-0.06	-0.18, 0.06	0.350	-0.01	-0.11, 0.09	0.895
Caregiver's education	0.04	-0.07, 0.15	0.492	0.02	-0.07, 0.10	0.686	0.02	-0.06, 0.10	0.639
Wealth index	0.02	-0.03, 0.07	0.485	0.01	-0.03, 0.05	0.727	0.01	-0.03, 0.04	0.840
Food insecurity	-0.01	-0.02,-0.01	0.003	-0.01	-0.02,-0.01	<0.001	-0.01	-0.02,-0.01	<0.001

Second stage: random effects regression: changes in anthropometry as a result of changes in dietary diversity

Variable	Weight (kg)			Height (cm)			BMI		
	β	95% CI	P	β	95% CI	P	β	95% CI	P
Dietary diversity	1.39	0.84, 1.93	<0.001	0.01	-1.26, 1.29	0.984	1.27	0.86, 1.68	<0.001
Intervention	0.21	-0.39, 0.81	0.495	-0.45	-2.05, 1.15	0.581	0.38	-0.02, 0.77	0.060
Follow-up	-1.18	-1.83,-0.53	<0.001	-1.54	-3.65,-0.06	0.042	-0.76	-1.23,-0.29	0.002
Age	0.13	0.12, 0.13	<0.001	-0.38	0.36, 0.40	<0.001	-0.01	-0.01, 0.01	0.582
Sex	-0.57	-1.07,-0.06	0.028	-1.03	-2.35, 0.29	0.127	-0.10	-0.43, 0.23	0.557
Caregiver's education	0.12	-0.29, 0.53	0.557	0.43	-0.53, 1.39	0.380	0.07	-0.19, 0.34	0.593
Wealth index	0.13	-0.06, 0.33	0.183	0.21	-0.25, 0.67	0.360	0.08	0.05, 0.20	0.241
Food insecurity	0.01	-0.02, 0.04	0.813	-0.04	-0.12, 0.04	0.297	0.03	0.01, 0.05	0.005

Weight model: n (pairs)=740; Model fit (R^2) = 67.2%; Height model n (pairs)=740; R^2 = 73.3%; BMI model: n (pairs)=740; R^2 = 2.6%

Intervention*follow-up= interaction term between intervention and follow-up

Intervention: subjects at the intervention compared to control arm

Follow-up: subjects at the follow-up compared to the baseline

Table 25: Effect of the intervention on nutrition status through changes in dietary diversity: Instrumental variable random effect regression

	First stage: Changes in dietary diversity at 6 months post-intervention								
	Underweight-model			Stunting-model			Thinness-model		
Variable	β	95% CI	P	β	95% CI	P	β	95% CI	P
Intervention*follow-up	1.11	0.94, 1.28	<0.001	1.10	0.97, 1.23	<0.001	1.10	0.96, 1.24	<0.001
Intervention	-0.08	-0.22, 0.07	0.310	-0.07	-0.20, 0.06	0.279	-0.07	-0.19, 0.05	0.254
Follow-up	0.48	0.35, 0.60	<0.001	0.45	0.36, 0.55	<0.001	0.46	0.36, 0.56	<0.001
Age	0.01	-0.01, 0.01	0.911	-0.01	-0.01, 0.01	0.433	-0.01	-0.01, 0.01	0.349
Sex	-0.06	-0.17, 0.06	0.354	-0.12	-0.11, 0.14	0.08	0.01	-0.10, 0.10	0.973
Caregiver's education	0.03	-0.07, 0.13	0.544	0.02	-0.06, 0.10	0.655	0.02	-0.06, 0.10	0.629
Wealth index	0.01	-0.04, 0.06	0.583	0.01	-0.03, 0.04	0.799	0.01	-0.03, 0.04	0.865
Food insecurity	-0.01	-0.02, -0.01	0.001	-0.01	-0.02, -0.01	<0.001	-0.01	-0.02, -0.01	<0.001

	Second stage: random effects regression: changes in nutrition status as a result of changes in dietary diversity								
	Underweight (WAZ<-2SD)			Stunting (HAZ<-2SD)			Thinness (BMIZ<-2SD)		
Variable	β	95% CI	P	β	95% CI	P	β	95% CI	P
Dietary diversity	-0.16	-0.25,-0.07	0.001	-0.01	-0.08, 0.05	0.632	-0.05	-0.10, 0.01	0.078
Intervention	-0.10	-0.18,-0.01	0.022	0.05	-0.01, 0.12	0.137	-0.04	-0.09, 0.01	0.121
Follow-up	0.13	0.03, 0.24	0.015	0.08	0.01, 0.15	0.047	0.03	-0.04, 0.09	0.408
Age	0.01	0.01, 0.01	0.021	0.01	0.01, 0.01	<0.001	0.01	0.01, 0.01	<0.001
Sex	-0.02	-0.09, 0.05	0.614	0.04	-0.02, 0.09	0.222	-0.01	-0.05, 0.04	0.887
Caregiver's education	0.01	-0.06, 0.21	0.934	0.01	-0.04, 0.05	0.844	-0.03	-0.07, 0.01	0.073
Wealth index	-0.03	-0.06, 0.06	0.047	0.01	-0.01, 0.03	0.361	-0.01	-0.03, 0.01	0.108
Food insecurity	-0.01	-0.01, 0.01	0.684	0.01	-0.01, 0.01	0.054	-0.01	-0.01,-0.01	0.022

Underweight model: n (pairs)=512; Model fit (R^2) = 3.1%; Stunting model n (pairs)=740; R^2 = 2.4%; Thinness model: n (pairs)=740; R^2 = 2.1%

Intervention*follow-up= interaction term between intervention and follow-up

Intervention: subjects at the intervention compared to control arm

Follow-up: subjects at the follow-up compared to the baseline

Table 25 also shows the results of the instrumental variable random effects regression on the nutrition status as the outcome variables. Similar to the anthropometry, three models were also constructed for a two-stage regression. The models were for underweight (WAZ<-2SD), stunting (HAZ<-2SD), and thinness (BMIZ<-2SD).

In the first stage regression where dietary diversity was the outcome variable, similar trend were observed. Following the intervention, dietary diversity increased significantly in the intervention arm and at the six-month final follow-up compared to the baseline in all the three models after adjusting for child's age and sex, caregiver's education level, household wealth index, and food insecurity as follows: underweight-model: $\beta = 1.11$, $p < 0.001$; stunting-model: $\beta = 1.10$, $p < 0.001$; and thinness-model: $\beta = 1.10$, $p < 0.001$). After adjusting for important confounders and covariates, feeding frequency generally improved at the final follow-up compared to the baseline (underweight-model: $\beta = 0.48$, $p < 0.001$; stunting-model: $\beta = 0.45$, $p < 0.001$; and thinness-model: $\beta = 0.46$, $p < 0.001$). In this model, dietary diversity seemed to be affected by the household food insecurity score. For example, a unit increase in household food insecurity was associated with a 0.01-unit decrease in dietary diversity score (p=0.001), in all three models.

The second stage in the analysis was also conducted to undertake an instrumental variable regression (**Table 25**). An increase in each unit of dietary diversity was associated with a 0.16-unit decrease in the child underweight ($p < 0.001$). However, the association with the dietary diversity and child stunting was not statistically significant ($\beta = -0.10$, $p = 0.632$). Also, such association was not significant for thinness (p=0.078). Being in the control arm was associated with poorer nutritional status at the follow-up stage with respect to an increase in dietary diversity. For example, a change in dietary diversity from baseline to the final follow-up was associated with an increase in underweight ($\beta = 0.13$, $p = 0.015$), stunting ($\beta = 0.08$, $p = 0.047$) or but not thinness (p=0.408).

A month increase in the age of a child was associated with a 0.01-unit increase in underweight ($p = 0.021$), a 0.01-unit increase in stunting ($p < 0.001$), and a 0.01-unit increase in thinness ($p < 0.001$). A

unit increase in household wealth index was associated with a 0.03-unit decrease in underweight (p =

0.047). A unit increase in household food insecurity was associated with 0.01-unit decrease in thinness

(p = 0.022).

5.4 Discussion

This study is the first cluster-randomized controlled trial to examine the efficacy of nutrition training in improving MLPs' nutrition education. It also serves as the first study to examine the efficacy of such training using standard WHO guidelines (41) and local determinants of undernutrition (49) toward improving feeding practices and growth among HIV-positive children. In this trial, nutrition training of MLPs improved their nutrition knowledge. Four aspects of knowledge improved post training. These were pediatric HIV, food preparation hygiene, feeding practices, and nutrition counseling.

This intervention also improved feeding frequency and dietary diversity among HIV-positive children at the 6-month follow-up in the intervention arm. At the six-month follow-up, a total of 160 HIV-positive children increased their feeding frequency to the optimum level (43.8% difference) and 103 children improved their dietary diversity score to three food types a day (29.5% increase compared to baseline), NNT=12.1. As a result, a net weight gain and related improvements in anthropometric indices and subsequently underweight and thinness among HIV-positive children of the intervention arm.

Follwing nutrition training of 16 MLPs, a total of 24 and 13 children who had underweight and thinness respectively before the intervention improved at a six-month follow-up, NNT=3.9. This change was not observed for stunting, a chronic form of undernutrition.

The following three pathways may help explain such gains in weight and related nutrition status. First, following the nutrition training of MLPs of CTCs in intervention group, their nutrition knowledge improved significantly. In Tanga region, these MLPs, who care for HIV-positive children, had a low level of nutrition knowledge before the training (49). However, through this intervention study, they could improve their knowledge significantly and thus might have exerted positive influences on the caregivers who attend their CTCs as explained below.

Second, in the intervention arm, the feeding practices of HIV-positive children improved significantly. During the formative research phase, 88.1% of 748 children had a feeding frequency (49) lower than that recommended by the WHO for HIV-positive children (41). About 62% of them also had low levels of dietary diversity. These factors were positively associated with poor nutrition status – in particular, underweight, thinness, and stunting – after adjusting for confounders and other variables (49). At the baseline stage of the current trial, the mean feeding frequency was 2.8/day and 2.6/day for children of the intervention and control arms, respectively. Following the intervention and final follow-up, the mean feeding frequency increased to 4.4/day and 3.1/day for the intervention and control arms, respectively. The mean total dietary diversity also increased more in the intervention arm. Even after adjusting for other variables, the intervention arm at follow-up had a significantly higher feeding frequency and dietary diversity. Therefore, nutrition training coupled with nutrition counseling improved feeding practices to a level similar to that observed in general and HIV-negative populations (50). In this study, the trained MLPs might have helped to transmit nutrition knowledge to caregivers as also shown in previous settings in general population (54, 57, 58). Like in previous studies, this was possible through the use available resources to improve feeding practices for their children (58, 149).

Third, the improvement of feeding practices brought about net weights gain of about 300g among the observed HIV-positive children in the intervention arm. After adjusting for confounders and other potential differences between groups, improved feeding practices were associated with increased weight in kg and BMI of HIV-positive children but not their height. It was also associated with a decrease in underweight status but similar associations were not found for stunting or thinness, which are related to child's height. Similarly, dietary diversity, which improved post intervention, was associated with improved weight gain and BMI but not height. It was further associated with decreasing underweight status but not stunting of thinness statuses.

Higher feeding frequency is known to increase the amount of food absorbed and replenishes losses sustained through catabolic processes triggered by HIV and opportunistic infections (41, 42, 209, 210).

Increased dietary diversity also improves appetite and thereby increases the amount of food consumed by a child, even apart from the added nutritional values (41, 42). The concomitant increases in both factors must have contributed to the observed weight gain among children in the intervention arm. On the other hand, it takes longer and sustained efforts to improve child height or longiturdinal growth. Therefore lack of association between feeding practices and stunting was probably due to a shorter follow up duration. Moreover, stunting is known to be associated with a myriad of chronic demographic disadvantages including poverty and food insecurity. Although the associations of stunting with wealth index and with food insecurity were not statistically significant, those factors were associated with dietary diversity.

Despite using a randomized controlled design, my study was not free of limitations. First, I depended on self-report and the recall of caregivers in measuring feeding practices. I relied on the self-reported feeding frequency and details of various foods a child was fed in a previous 24 hours. Caregivers may forget about what they fed their children and the frequency of such feeding. Moreover, caregiver may feel obliged to state a higher frequency to please the health worker who constant asks for improved practices. However, even under such limitation, it would have been natural for both intervention and control arms to have been affected in the same way. The difference at the end of the trial may therefore reflect a near correct change in feeding practices. Moreover, the current findings at baseline were not significantly different from those identified in the formative research (49).

Second, I lost a total of 31 pairs of HIV-positive children and their caregivers in my final analyses. Because of strict ethical guidelines, I could not interview children who came alone to the CTCs, and unaccompanied by their caregivers (65). Details of the questionnaire also called for a caregiver to answer. These are feeding practices, food preparation hygiene, household characteristics, and food insecurity. However, such children who were lost at the final follow-up were almost evenly distributed in both arms.

Third, a 6-month follow-up may be too short to observe significant changes in long-term outcome variables such as height. This limitation might have been behind non-significant association between intervention and stunting. However, an important objective in this research was to examine effectiveness of nutrition training on feeding practices that can modify growth of HIV-positive children. Under such guiding hypothesis, this intervention improved important feeding practices (feeding frequency and dietary diversity). Such improvement further brought about positive changes into the weight gain and subsequent related nutrition status such as underweight and thinness. Therefore, this nutrition specific intervention can also be vital to chronic forms of undernutrition including stunting in a long term provided other basic determinants are also improved. A mixture of nutrition specific and sensitive may help to address stunting.

Despite the limitations, this is set to be the first study to examine efficacy of nutrition training of health workers particularly MLPs in a food secure region, on their nutrition knowledge. It is also the first study to examine efficacy of such intervention on feeding practices, anthropometry, and nutrition status of HIV-positive children. In practical sense, this study is the first trial to use the new WHO guidelines on integrating nutrition care for HIV-positive children aged 6months to 14 years.

In conclusion, providing nutrition training to MLPs effectively improved their nutrition knowledge. In turn, knowledge gained improved caregivers' feeding practices of HIV-positive children in Tanga region, Tanzania. Finally, improved feeding practices brought about a small weight gain, though not linear growth, among HIV-positive children in this food-secure region. Even where the health workforce is limited, providing nutrition training to the available workforce can help to ameliorate underweight among HIV-positive children. Nutrition training alone, however, may not be enough to ameliorate linear growth faltering. Efforts are thus needed to improve food insecurity, poverty, and education levels among the caregivers of HIV-positive children toward bringing about lasting and sustainable improvements in nutrition.

Chapter 6:

General discussion, conclusions, and recommendations

6.1 General discussion of the main results

This study aimed to examine the efficacy of nutrition training of health workers on improving their competence and children's feeding practices and nutrition status. To address such objective, two systematic reviews were conducted. Also, the formative research followed by the cluster RCT were conducted to examine the efficacy of such intervention among HIV-positive children.

Results of systematic reviews revealed that, nutrition training of health workers improves their knowledge, counseling skills, and competence to manage child undernutrition in various context (54). As the result of this intervention, feeding practices of young children improved. These included feeding frequency, energy intake, and dietary diversity (50).

The formative research found poor feeding practices HIV-positive children attending CTCs in a food rich region in Tanga, Tanzania. About 88% of HIV-positive children recruited in this study were fed at a lower than recommended frequency and 62% had low dietary diversity score. These were associated with undernutrition, which was also unprecedented in this population. About 62% of HIV-positive children attending CTCs were stunted, while 39% suffered from low weight for their age (49). Poor feeding practices in Tanga were associated with low caregiver's nutrition knowledge, low education level, poverty, and household's food insecurity (49).

Nutrition training intervention was provided to the MLPs of intervention arm as an integrated approach to the nutrition care of HIV-positive children in the cluster RCT (65). Nutrition knowledge of MLPs improved post-training. The improved nutrition knowledge was translated into tailor-made nutrition counseling and management of undernutrition using locally available resources. As a result, feeding practices significantly improved among HIV-positive children in the intervention arm. This included feeding frequency and dietary diversity. Towards the end of the six-months follow-up, HIV-positive children in the intervention arm had a modest 300g-weight gain. It was translated into significant improvement in underweight and thinness status of HIV-positive children. These are novel findings in the context of MLPs and HIV-positive children.

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Nutrition training improved nutrition knowledge of MLPs caring for HIV-positive children in Tanga, Tanzania. Nutrition training was also effective in contexts of HIV-negative populations and with various health cadres (53, 75-77). Inservice nutrition trainings are important to counteract the effect of lack of nutrition trainings of health workers during professional trainings (52, 71, 72).

Nutrition training of MLPs also improved feeding practices among HIV-positive children, even after adjusting for socio-demographic characteristics including food insecurity. After the standard WHO nutrition training, MLPs could identify nutrition needs of HIV-positive children, nutrition status, feeding status, nutrition care plan, and conduct counseling based on individual needs (41). Similar findings was reported in the context of general population (54).

Nutrition counseling was based on existing resources, household food security, and other identified determinants for each child. Emphasis was put on changing practices and utilizing available and affordable foods in their households or environment. For example, by dividing the larger portions of meals into many smaller but adequate sizes and provide it at a higher frequency may improve absorption of nutrients. Following the training, health workers could teach caregivers the importance of vegetables and fruits, which are plenty in their environment but were not consumed as routine (49). Emphasis of proper feeding behaviors, frequent monitoring, and follow-up helped to keep caregivers on alert about proper feeding practices.

A modest gain in average weight was observed among HIV-positive children in the intervention arm. This was associated with improved feeding frequency and dietary diversity even after adjusting for other confounders and covariates. The formative research had found a high proportion of HIV-positive children with low feeding frequency and it was associated with undernutrition (49). The standard WHO's nutrition training used (41) emphasized on identifying local determinants of undernutrition among HIV-positive children and work towards improving them. In this study, feeding practices were emphasized from training to counseling. The observed modest weight gain was therefore a result of frequent counseling and monitoring of feeding practices.

Height and related nutrition status, stunting, did not improve following nutrition training and counseling. This may be due to two reasons. First, the six-months follow-up was not enough to see any significant linear growth. Second, both the formative research (49) and the cluster RCT found stunting to correlate with structural determinants including poverty, food insecurity, and low education levels of caregivers. Nutrition training alone may not address such factors. A multitude of efforts to target them may help to also address stunting (35). Studies among children in the general populations with regional differences also showed similar results (55, 56).

High proportions of HIV-positive children had already been initiated on ART in both formative research and cluster RCT. As high as 89% of HIV-positive children recruited to participate in formative research and 87.5% in the cluster RCT were on ART. All participants were registered to receive care and treatment for HIV-positive patients in CTCs. Those who were not yet on ART had not yet fulfilled the criteria set for ART initiation according to the national guidelines for care and treatment (168). Such criteria recommend all HIV-positive children below 12 months of age to start ART. For those aged above one year, ART initiation depends on immunological and clinical stage of the disease. For example, children with clinical stage 1 and 2 but with CD4 count <25% or clinical stage 3 or 4 should start ART.

HIV-positive children had high adherence to ART throughout this study. This is despite the selected households food insecurity, poor feeding practices and undernutrition, low caregiver's education level, or poverty. Such success is a result of routine adherence counseling, monitoring, and follow up on each CTC visit for every caregiver. Feeding practices and nutrition status may also improve if similar efforts are replicated for nutrition counseling, as for ART adherence counseling.

6.2 Conclusions

Nutrition training of health workers has potential to improve nutritional knowledge, skills and competence of heathworkers to manage child undernutrition. This intervention can also improve poor feeding practices including low feeding frequency, dietary diversity and energy intake in different context and regions of the world.

Nutrition training of health workers was also effective in improving nutrition knowledge of MLPs in Tanga, Tanzania. Nutrition knowledge of MLP improved following the nutrition training that utilized used the standard WHO's guidelines for HIV-positive children. This implies the potential of such intervention in the context of few and less qualified health workers of developing countries.

HIV-positive children suffer from unprecedented magnitudes of undernutrition including stunting, underweight, wasting, and thinness. Factors associated with undernutrition in Tanga, also include poor feeding practices. HIV-positive children in this food rich region are fed at a lower than recommended frequency and dietary diversity.

Poor feeding practices among HIV-positive children attending CTCs were associated with poverty, food insecurity, low education level of caregivers, and lack of nutrition knowledge. Moreover, restrictive feeding beliefs and traditions were also associated with such poor feeding practices.

Nutrition training of MLPs can also improve feeding practices of HIV-positive children if they conduct tailored-made counseling based on locally available resources. Improved feeding practices can therefore bring about weight gain. This intervention may not improve linear growth if other persistent determinants are not addressed. They include food insecurity and hunger, poverty, and caregivers' low education levels.

6.3 Policy implication

Results of this thesis can be used to guide policy makers on adopting nutrition training of health workers in their nutrition strategic plans. This thesis shows that nutrition training of available workforce has the potential to address the knowledge gap they have as a result of traditional professional trainings in medical and nursing schools. By providing inservice nutrition training, quality of services by the available health workers can improve. Such services include nutrition counseling, management of undernutrition, and prevention of determinants of child undernutrition. It further shows that, nutrition training can benefit all cadres of health from the highly qualified to the midlevel providers.

The results of this thesis indicated high magnitudes of undernutrition among HIV-positive children even in food-rich areas. It emphasizes vulnerability of HIV-positive children on undernutrition compared to the HIV-negative or general population. Moreover, undernutrition in such areas is associated with poor feeding practices, which can be prevented. Therefore, undernutrition in this context can be ameliorated if low feeding frequency and dietary diversity are addressed. Also it is important to design interventions that target households with food insecurity, in poverty, and with caregivers with low level of education.

Nutrition trainings of midlevel providers can improve feeding practices and undernutrition of HIV-positive children. It is important for the policy makers to adopt the recent WHO guideline for integrated approach to the nutrition care (41). It is also important to strengthen country's nutrition governance by responding to the pertinent nutrition threats for such special groups and address them using evidence generated from within the country (197). Evidence from this thesis points out areas of improvement in Tanzania and other regions with similar characteristics.

6.4 Remaining research gaps

HIV-positive children in the ART-era are expected to have longer life expectancy owing to the increased coverage of ART. However, undernutrition at their young age predispose them to poor cognitive, intellectual development, schooling and therefore future income. Child undernutrition also increases the risk of non-communicable diseases and early adulthood mortality (35). This phenomenon is well known among children of general population (35, 211, 212). However, evidence is still lacking among HIV-positive children. Examining independent effects of HIV and undernutrition on cognitive and mental development needs a long-term follow-up.

Research is also lacking on the long-term effects of ART on nutrition metabolism and effects thereof. Some of antiretroviral drugs have been associated with interference of lipid metabolism leading to lipodystrophy. However, evidence is available among adults only and on a few types of drugs.

Future longitudinal research should also investigate the effects of long-term exposure to antiretroviral drugs on body functions, interllectual, cognitive, and behavior aspects among children. Antiretroviral drugs are known to permeate blood brain barrier among adults. This has been associated with impairment of brain functions and led to side effects. To this end evidence is also not available for children.

As they live longer, HIV-positive children are subjected to lifestyle-related diseases. As a result of poor feeding practices, PLHIV are also at risk of obesity, which may predispose them into non-communicable diseases. Studies should also examine if ART has compounding effects on such diseases.

6.5 Recommendations

Results of this thesis call for scaling up of nutrition training of health workers through inservice trainings or compulsory continuing medical education. Such training should target all cadres available and who care for children including HIV-positive ones. Nutrition training should emphasize addressing the local determinants of poor feeding and undernutrition to be effective. Such nutrition trainings should be tailor-made in forms of Continuing Medical Education (CME), Continuing Professional Development (CPD), and mandatory in-service trainings in nutrition seminars or workshops. Nutrition trainings specific for HIV-positive children and those of children of general population can have a lasting impact in changing health workers practice including routine nutrition counseling and management of nutrition related conditions.

This thesis recommends training of the available midlevel providers who cares for HIV-positive children in the context of HIV and human resources for health constraints. Integrating nutrition care into the existing CTCs infrastructures can improve poor feeding practices and unprecedented magnitudes of undernutrition in Tanzania and other countries with similar characteristics. It is therefore imperative to scale up nutrition trainings using the WHO's guidelines for integrated approach to nutrition care of HIV-positive children aged 6months to 14 years.

To ameliorate magnitudes of stunting, interventions should focus more persistent determinants. Interventions should be designed to target households in poverty, food insecurity, and with caregivers who have low levels of education.

A long-term follow up is recommended to see the long-term effectiveness of such training in health workers knowledge retention, feeding behaviors, and linear growth of HIV-positive children. Also, such follow-up can help to examine effectiveness of training on HIV-related parameters including CD4 count, viral load suppression, and longevity of HIV-positive children.

RCT. This study would have not been possible without their readiness to spend more time than normal in their routine care.

"A good head and good heart are always a formidable combination. But when you add to that a literate tongue or pen, then you have something very special."--Nelson Mandela--

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Appendix 1: The map of Tanzania and Tanga region

Tanga region
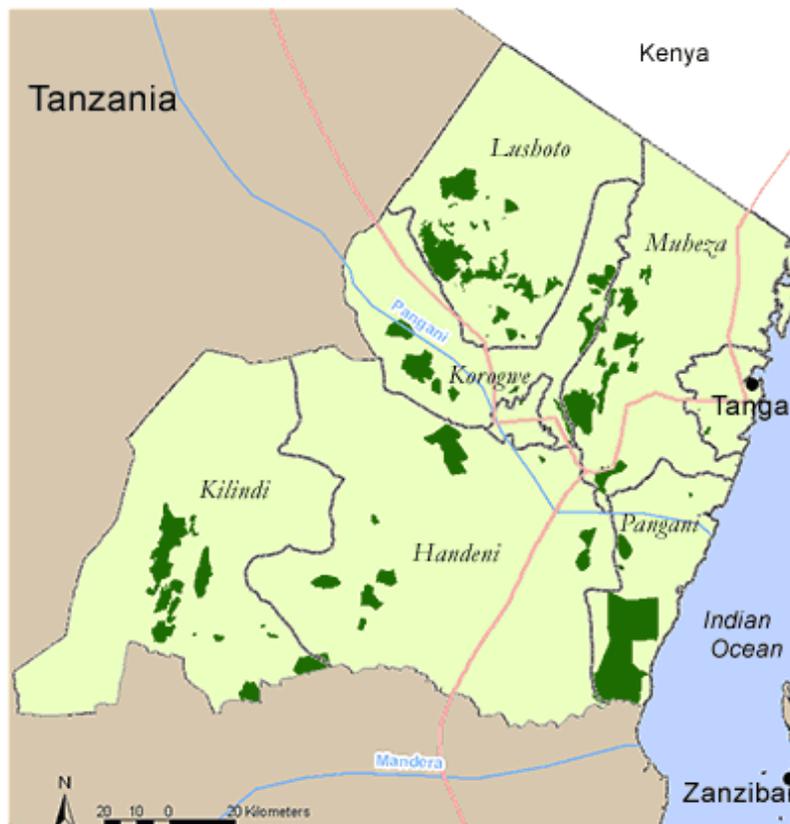
Appendix 2: Research questionnaire - English version (Cross sectional and Baseline)

RESEARCH QUESTIONNAIRE   Date __/__/____   Serial number l l-l__l__l__l

TITLE: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Name of the interviewer:…………………………………Name of health facility…..………

FILE NO/CTC CARD NO.……..................... District……………………

A. Socio demographic characteristics

I. Child information

1. Age (months)………..

2. Sex □1. M   □ 2. F

3. What is the parental status of this child

    □ 1. Both parents are alive   □ 2. Only mother is alive

    □ 3. Only father is alive   □ 4. Both parents are dead

4. What is the place of residence of this child?

    □ 1. Own family home   □ 2. Orphanage

    □ 3. Blood relative's home   □ 3. Guardian's/not relative's home

5. What is the total number of children (including this child) in your place of residence?

    ....

II. Parent or Guardian Socio-demographic information

1. What is your age (years)? ……

2. Relationship with the child: □ 1. Mother □ 3. Sister □ 4. Aunt □ 5. Grandmother □ 6. Guardian □ 7.Other

3. Education level (highest reached) □ 1. None □ 2. Primary school □ 3. Secondary school

□ 4. College/ University   □ 5. Informal education

4. Can you read and write? □ 1. Yes   □ 2. No

5. Religion □ 1. Moslem   □ 2. Christian   □ 4. None   □ 5. Other

   (specify)………………

6. Current marital status □ 1. Single   □ 2. Widowed   □ 3. Divorced   □ 4. Separated

7. Besides you, does your husband/partner have other wives/women?

   □ 1. Yes   □ 2. No   □ 3. Don't know

8. During the last 12 months what was your main activity?

   □ 1. Housewife

   □ 2. Employed

   □ 3. Agriculture (farming/livestock)

   □ 4. Fishing

   □ 5. Self employed (not in agriculture)

   □ 6. Not working (student, unable to work, others)

9. How much money does the household get/month?............................Tsh.

10. Do you drink alcohol (beer, local brew)?

   □ 1. Everyday   □ 2. Sometimes   □ 3. Occasionally   □ 4. No

III. Household assets ownership (Wealth index)

1) What is the main source of drinking water for members of your household?

   □ 1. Piped water   □ 2. Water from open well   □ 3. Covered well

   □ 4. Bare hole   □ 5. Surface water   □ 6. Rain water

   □ 7. Tanker truck   □ 8. Water vendor   □ 9. Bottled water

1. What kind of toilet facility does your household have?

   □ 1. Flush toilet   □ 2. Pit toilet/latrine   □ 3. No facility

   □ 4. Bush/field   □ 5. Shared with neighbor

2. Does your household have/own?   Yes   No

a.	Electricity	1	2
b.	Paraffin lamp	1	2
c.	A television	1	2
d.	A radio	1	2
e.	A telephone /mobile phone	1	2
f.	An iron (charcoal/electric)	1	2
g.	Refrigerator	1	2
h.	Bicycle	1	2
i.	Motor cycle	1	2
j.	Car (motor car)	1	2
k.	A farm	1	2

3. What type of fuel does your household mainly use for cooking?

   □ 1. Electricity   □ 2. Gas   □ 3. Kerosene

   □ 4. Charcoal   □ 5. Firewood   □ 6. Solar

4. What is the main source of energy for lighting?

   □ 1. Electricity   □ 2. Solar   □ 3. Gas   □ 4. Kerosene

   □ 6.Candles   □ 7 Wick lamp   □ 8. Firewood

5. What are the main materials for of the floor

   □ 1. Earth/sand   □ 2. Cement   □ 3. Ceramic tiles   □ 4. Finished floor/wood

6. Is the house you live owned by you?

   □ 1. Yes   □ 2. Rented   □ 3. Inherited

7. How many meals do your household have/day………………

8. In the past week, how many days did your family consume meat?.............

9. How often in the last year did you have problems in satisfying the food need of the household?

   □ 1. Never   □ 2. Seldom   □ 3. Sometimes   □ 4. Often   □ 5. Always

B. Dietary/ feeding history

I. Child nutrition history

1. Was this child ever breastfed?

     □ 1. Yes   □ 2. No   □ 3. Don't know

4. Are you still breastfeeding this child? □ 1. Yes   □ 2. No

5. How many months did this child receive only breast milk?..................................

6. How many months in total was this child breastfed?...................................

7. How many times did you breastfeed from last night between sunset and sunrise?

     □ 1. Night time feeding………….. □ 2. Day time feeding………………..

8. Is this child on other types of foods other than breast milk?

     □ 1. Yes   □ 2. No

9. How many times did the child eat (solid, semisolid or soft foods) other than breast

milk yesterday day/night?

     □ 1. Number of times during day…………….

     □ 2. Number of times during night……………..

10. Does this child receive any nutrient supplements?

     □ 1. Yes.   □ 2. No

11. Frequency……………………../day

12. Type □1. Plumpy nuts   □ 2. Other fortified foods………………………

II. Child's Dietary Diversity Scale.

1. Now I would like to ask you about liquids drank yesterday by this child.

     In total, how many times during the day did this child drink?   Number

          a) Plain water   ……………

          b) Commercially produced infant formula   ……………

          c) Any other milk (tinned, powdered, Fresh animal's milk)............

          d) Fruit juice   ……………

e) Any other liquid   ……………

2. How many times yesterday during the day or night did this child eat?

  a) Bread, maize (ugali) porridge, millet, rice, sorghum..................

  b) Pumpkins, carrots, sweet potatoes (orange/yellow)……………..

  c) Any other food made from roots or tubers eg. Cocoyam, Irish potatoes, white yam, cassava, white sweet potato…………….

  d) Any other green/leafy vegetables such as a marath, cassava, pumpkin, greens, spinach, others………………..

  e) Mango or papaya……………

  f) Other fruits/vegetables………………..

  g) Red meat (beef, muton)……

  h) Poultry (chicken, duck)…..

  i) Fish….,

  j) Egg………….

  k) Any other food from legume (beans, groundnuts, sunflower)………….

  l) Cheese, milk, yoghurt………………

  m) Any other foods from oil/fat e.g. Margarine, ghee, butter…………….

  n) Other foods……………………

III. Feeding practices in the previous 24 hours

Meal for	Time of the day	Description of the food, drink, or snack	Local unit used (bowl, plate, cup)	Amount (gm)	Food code
MORNING					
AFTERNOON					
EVENING					
NIGHT					

C. House Hold Food Insecurity Access Scale

NO	QUESTION	RESPONSE OPTIONS	CODE
1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Y es	|___|
1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Y es	|___|
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	|___|
3.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of lack of resources to obtain other types of food?	0 = No (Skip to No.5) 1=No	|___|
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	|___|

5.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	|___|
6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	|___|
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	|___|
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes	|___|
9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|

D. Child's health and opportunistic infection history.

1. In the last 6 months, did this child suffer from the following diseases (how many times)

    a) Cough, difficult in breathing   (………………….)

    b) Diarrhea   (………………….)

    c) Tuberculosis   (………………….)

    d) Fever/malaria   (………………….)

    e) Convulsions   (………………….)

    f) Candidiasis (Oral/esophageal)   (…………………..)

    g) Intestinal helminthes   (…………………..)

2. During the past 6 months, how many times was this child hospitalized………….

3. What was the birth weight of this child…………………….

E. Child's anthropometric measurements

1. Weight (gm) …………

2. Height (cm) ………….

3. MUAC (cm) …………

F. ART and CTC specific questions

1. At first enrollment to CTC, what was the (**check the CTC cards No.1&2**)

    a) Age (months) of the child………..

    b) CD4 count………….

    c) HIV clinical stage …………

    d) Hb ………………….

2. During last CTC visit, what was the **MOST** recent (**check the CTC cards No.1&2**)

    a) CD4 count ………….(indicate the date taken)

    b) Hb (most recent)………….(indicate the date taken)

3. Does this child receive ART?   □ 1. Yes   □ 2. No

4. When did the child start taking ART? Year….. Month…. Day..(**Check CTC cards**)

5. What combination of medication is the child receiving?

  1) AZT+3TC+NVP
  2) d4T+3TC+NVP
  3) ABC+3TC+NVP
  4) AZT+3TC+EFV
  5) ABC+3TC+EFV

6. Please go back to 4 days ago, how many ARV pills did the child take in the morning

   /afternoon/ night of each of the following days? What time did he/she take?

	Medicine	Morning	Afternoon	Evening
Yesterday		#..........at……..	#..........at……..	#..........at……..
2 days ago		#..........at……..	#..........at……..	#..........at……..
3 days ago		#..........at……..	#..........at……..	#..........at……..
4 days ago		#..........at……..	#..........at……..	#..........at……..

7. What id the highest reached HIV clinical Stage of the child? (Check the CTC cards)

Appendix 3: Research questionnaire - Swahili version (Cross sectional and cRCT - Baseline)

DODOSO LA UTAFITI　　　**Tarehe__/__/___**　　　**Namba l_l-l__l__l__l**

Kichwa cha utafiti: **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania**

Jina la msaili:…………………… 　　Jina la kituo cha afya…..………….....

Namba ya kadi/CTC ……………… 　　Jina la mtoto (initials)………………

I. *Taarifa kuhusu Mtoto husika*

1. Umri (miezi) ... ...

2. Jinsia　□1. Me　　　　□ 2. Ke

3. Hali ya wazazi wa mtoto huyu ikoje?
    □ 1.Wazazi wote wako hai　　　□ 2. Mama tu yuko hai
    □ 3. Baba tu yuko hai　　　　□ 4. Wazazi wote wameshafariki

II. *Taarifa kuhusu Mzazi/Mlezi*

1. Nini uhusiano wako na mtoto huyu:
    □ 1. Mama □ 2. Shangazi/ Dada □ 3. Bibi/babu □ 4. Mlezi □ 5. Nyingine

2. Nini kiwango chako cha elimu?
    □ 1. Sina elimu　　□ 2. Elimu ya msingi　　□ 3. Elimu ya sekondari

    □ 4. Chuo/Kikuu　　□ 5. Elimu isiyo rasmi

III. *Uwezo wa kiuchumi wa Kaya, umiliki*

1. Nini chanzo kikuu cha maji ya kunywa kwa wana kaya yako?
    □ 1. Maji ya bomba　　□ 2. Kisima kilicho wazi　　□ 3. Kisima kilichofunikwa

    □ 4. Shimo lililo wazi　□ 5. Maji yaliyo wazi(mto, chemchemi)　□ 6. Mvua
    □ 7. Gari la kubebea maji　□ 8. Maji ya kununua mtaani　□ 9. Maji ya chupa

2. Ni aina gani ya choo mnachotumia katika kaya yenu?
    □ 1. Choo cha kuvuta (flush) □ 2. Choo cha shimo □ 3. Hakuna choo
    □ 4. Kichakani / shamba　　□ 5. Tunashirikiana na jirani

3. Kaya yako inamiliki vitu vifuatavyo?

	Ndiyo	Hapana
a. Umeme	1	2
b. Taa ya mafuta ya taa	1	2
c. Runinga/TV	1	2
d. Radio	1	2
e. Simu ya mezani/mkononi	1	2
f. Pasi /ya mkaa / umeme	1	2
g. Friji	1	2
h. Baisikeli / Pikipiki	1	2
i. Shamba	1	2

4. Aina gani ya nishati kaya yako hutumia **zaidi** kwa ajili ya kupikia?
   □ 1. Umeme   □ 2. Gesi   □ 3. Mafuta ya taa
   □ 4. Mkaa   □ 5. Kuni   □ 6. Nishati ya jua

5. Nini chanzo **kikuu** cha nishati kwa ajili ya taa?
   □ 1. Umeme   □ 2. Jua   □ 3. Gesi   □ 4.Taa ya Chemli
   □ 5. Koroboi   □ 6.Candles   □ 7. Kuni

6. Nyumba yenu ina sakafu ya aina gani?

   □ 1. Ardhi / mchanga   □ 2. Sementi   □ 3. Vigae (tiles)

7. Nyumba hii unayoishi inamilikiwa na wewe?
   □ 1. Ndiyo   □ 2. Ya kukodi/Kupangisha   □ 3. Ya urithi

8. Ni mara ngapi katika mwaka uliopita ulipata matatizo katika kutosheleza mahitaji ya chakula kwa ajili ya familia yako?

   □ 1. Haijatokea   □ 2. Mara chache □ 3. Wakati mwingine

   □ 4. Mara nyingi □ 5. Daima/Mara zote

B. Historia ya lishe

I. Lishe ya mtoto

1. Je bado mtoto huyu ananyonya? □ 1. Ndiyo   □ 2. Hapana

2. Je mtoto huwa anakula chakuna cha aina nyingine mara ngapi?

   □ Mchana………□ Usiku………□ Jumla ……..

II. Kipimo cha vyakula mbalimbali

1. Sasa ningependa kukuuliza kuhusu vinywaji alivyokunywa jana huyu mtoto.

   Weka alama kwenye kinywaji alichotumia jana

   a.   Maziwa kopo, au ya wanyama

   b.   Juisi ya matunda iliyotengenezwa nyumbani

   c.   Juisi ya kiwandani

2. Je ni chakula gani kati ya vifuatavyo mtoto huyu alikula jana mchana na usiku?

   Weka alama kwenye kundi la chakula alichokula

   a.   Mkate, ugali, wali au viazi

   b.   Boga, karoti, viazi vitamu

   c.   Viazi vitamu, mihogo

   d.   Mboga za majani kama spinachi, mchicha, kebichi

   e.   Maembe, papai

   f.   Matunda mengine, au mboga za majani

   g.   Nyama nyekundu (ya ngombe, mbuzi, kondoo)

   h.   Nyama nyeupe (nguruwe, kuku, bata)

   i.   Samaki

   j.   Mayai, ………….

   k.   Karanga, maharage, alizeti………….

l. Maziwa mtindi, jibini, ………………

m. Siagi, mafuta ya samaki ……………

n. Vyakula vinginevyo ……………………

3. Mchanganuo wa mlo wa mtoto siku ya jana

	Muda	Aina/jina la chakula, kinywaji, kitafunwa	Kipimo (Bakuli, sahani, Kikombe)
Asubuhi			
Mchana			
Jioni			
Usiku			

4. Maandalizi ya chakula na usafi

1. Je kwa siku ya jana mtoto huyu alikunywa maji yaliyochemshwa?
    1. Ndiyo   2. Hapana
2. Je kwa siku ya jana, motto huyu alikula matunda yaliyosafishwa?
    1. Ndiyo   2. Hapana
3. Je Mtoto huyu alikula chakula kilichoandaliwa siku hiyo hiyo?
    1. Ndiyo   2. Hapana

C. Skeli ya uhakika wa chakula nyumbani

NO	Swali	Jibu	CODE
1.	Katika wiki NNE zilizopita, uliwahi kuhofia kuwa kaya yako haitakuwa na chakula cha kutosha?	0 = Hapana (Nenda No.2) 1=Ndiyo	|___|
1.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
2.	Katika wiki NNE zilizopita, je wewe ama yeyote nymbani kwako aliwahi kula aina ya chakula ambacho hakukitaka kwa sababu ya ukosefu wa	0 = Hapana (Nenda No.3) 1=Ndiyo	|___|

		fedha?		
2.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
3.	Katika wiki NNE zilizopita, Je wewe ama yeyote nyumbani kwako alikula aina chache za vyakula kwa sababu ya ukosefu wa fedha?	0 = Hapana (Nenda No.4) 1=Ndiyo	|___|
3.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
4	Katika wiki NNE zilizopita Je ilikupasa wewe ama yeyote nyumbani kwako kula vyakula ambavyo hamkutaka kula kwa sababu ya ukosefu wa fedha?	0 = Hapana (Nenda No.5) 1=Ndiyo	|___|
4.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
5.	Katika wiki NNE zilizopita Je ilikupasa wewe ama yeyote nyumbani kwako kula chakula kidogo kwa sababu hakukuwa na chakula cha kutosha?	0 = Hapana (Nenda No.6) 1=Ndiyo	|___|
5.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
6.	Katika wiki NNE zilizopita Je ilikupasa wewe ama yeyote nyumbani kwako kula chakula mara chache sababu hakukuwa na chakula cha kutosha?	0 = Hapana (Nenda No.7) 1=Ndiyo	|___|
6.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
7.	Katika wiki NNE zilizopita, kuna wakati HAKUKUWA na chakula nyumbani kwa sababu ya uhaba wa fedha za kununulia chakula?	0 = Hapana (Nenda No.8) 1=Ndiyo	|___|
7.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|
8.	Katika wiki NNE zilizopita Je ilikupasa wewe ama yeyote nyumbani kwako alilala njaa bila kula kwa sababu ya kukosekana chakula cha kutosha?	0 = Hapana (Nenda No.9) 1=Ndiyo	|___|
8.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne)	

		2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	
9.	Katika wiki NNE zilizopita Je ilikupasa wewe ama yeyote nyumbani kwako alishinda mchana na usiku bila kula kwa sababu ya uhaba wa chakula nyumbani?	0 = Hapana (Mwisho) 1 = Ndiyo	|___|
9.a	Ni mara ngapi hili lilitokea?	1 = Mara chache (Moja ama mbili kwa wiki nne) 2 = Mara kadhaa (Tatu hadi Tisa kwa wiki nne) 3 = Mara nyingi (Zaidi kumi kwa wiki NNE)	|___|

D. Hostoria ya magonjwa nyemelezi ambukizi na afya ya mtoto

1. Katika miezi 6 iliyopita, Je, mtoto huyu ameshawahi kuugua magonjwa yafuatayo?

   (mara ngapi?)

   a. Kikohozi,/ Kupata shida ya kupumua   (... ... ...)

   b. Kuhara   (... ... ...)

   c. Kifua kikuu   (... ... ...)

   d. Malaria   (... ... ...)

2. Katika miezi 6 iliyopita ni mara ngapi mtoto amelazwa hospitali? ... ...

E. Uchunguzi wa mwili (msaili atamuangalia na kumpima mtoto):

   a). Uzito(gm) ... ...

   b). Urefu (cm) ... ...

   c). MUAC (cm) ... ...

F. Maswali maalumu kwa CTC na ART

1. Katika mahudhurio ya mwisho ya CTC, nini ilikuwa

   a). CD4 ……... ... ...   Tarehe…………………..

   b). HB... ... ...   Tarehe…………………..

2. Je mtoto amefikia hatua gani ya juu zaidi ya ugonjwa wa UKIMWI?

   HIV clinical stage……………

3. Je, mtoto huyu anapata Dawa za kupunguza makali ya virusi vya UKIMWI (ARV)?

   □ 1. Ndiyo   □ 2. Hapana

4. Mtoto huyu alianza kutumia ARV lini (CTC card)..Tarehe………………………..

5. Mtoto huyu anatumia mchanganyiko gani wa ART?
   1. AZT+3TC+NVP
   2. d4T+3TC+NVP
   3. ABC+3TC+NVP

4. AZT+3TC+EFV
5. ABC+3TC+EFV

6. Tafadhali fikiria siku NNE za nyuma, ni vidonge/dozi ngapi vya ARV mototo huyu alikunywa asubuhi/mchana/jioni? Ni muda gani alitumia?

	Asubuhi	Jioni/Usiku
Jana	vidonge...........saa……..	vidonge...........saa……..
Juzi (siku 2 nyuma)	vidonge...........saa……..	vidonge...........saa……..
Mtondo (siku 3 nyuma)	vidonge...........saa……..	vidonge...........saa……..
Mtondogoo (siku 4 nyuma)	vidonge...........saa……..	vidonge...........saa……..

Appendix 4: Research questionnaire - English version (Follow up)

RESEARCH QUESTIONNAIRE   Date __/__/____   Serial number l l-l__l__l__l

TITLE: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Name of the interviewer:………………………………………Name of health facility…..………

FILE NO/CTC CARD NO.……..................... District……………………

A. Socio demographic characteristics

I. Child information

6. Age (months)………..

B. Dietary/ feeding history

I. Child feeding frequency

1. How many times did the child eat (solid, semisolid or soft foods) other than breast   milk

yesterday day/night?

□ 1. Number of times during day…………….

□ 2. Number of times during night……………..

II. Child's Dietary Diversity Scale.

2.   Now I would like to ask you about liquids drank yesterday by this child.

In total, how many times during the day did this child drink?   Number

e) Plain water   ……………

f) Commercially produced infant formula   ……………

g) Any other milk (tinned, powdered, Fresh animal's milk)............

h) Fruit juice   ……………

e) Any other liquid   ……………

2. How many times yesterday during the day or night did this child eat?

    o) Bread, maize (ugali) porridge, millet, rice, sorghum..................

    p) Pumpkins, carrots, sweet potatoes (orange/yellow)……………..

    q) Any other food made from roots or tubers eg. Cocoyam, Irish potatoes, white yam, cassava, white sweet potato…………….

    r) Any other green/leafy vegetables such as a marath, cassava, pumpkin, greens, spinach, others………………..

    s) Mango or papaya……………

    t) Other fruits/vegetables………………..

    u) Red meat (beef, muton)……

    v) Poultry (chicken, duck)…..

    w) Fish….,

    x) Egg………….

    y) Any other food from legume (beans, groundnuts, sunflower)………….

    z) Cheese, milk, yoghurt………………

    aa) Any other foods from oil/fat e.g. Margarine, ghee, butter…………….

    bb) Other foods……………………

III. Feeding practices in the previous 24 hours

Meal for	Time of the day	Description of the food, drink, or snack	Local unit used (bowl, plate, cup)	Amount (gm)	Food code
MORNING					
AFTERNOON					
EVENING					
NIGHT					

C. House Hold Food Insecurity Access Scale

NO	QUESTION	RESPONSE OPTIONS	CODE
1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Y es	|___|
1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Y es	|___|
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	|___|
3.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of lack of resources to obtain other types of food?	0 = No (Skip to No.5) 1=Yes	|___|
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	|___|
		1 = Rarely (once or twice in the past four weeks)	

5.a	How often did this happen?	2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	|___|
6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	|___|
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	|___|
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes	|___|
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	|___|
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
9.	In the past four weeks, did you	0 = No (questionnaire is finished) 1 = Yes	|___|

	or any household member go a whole day and night without eating anything because there was not enough food?		
9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	|___|

D. Child's health and opportunistic infection history.

4. In the last 1 month, did this child suffer from the following diseases (how many times)

      h) Cough, difficult in breathing   (………………….)

      i) Diarrhea   (………………….)

      j) Tuberculosis   (………………….)

      k) Fever/malaria   (………………….)

      l) Convulsions   (………………….)

      m) Candidiasis (Oral/esophageal)   (………………….)

5. During the past 1 month, how many times was this child hospitalized………….

E. Child's anthropometric measurements

4. Weight (gm) …………

5. Height (cm) ………….

6. MUAC (cm) …………

F. ART and CTC specific questions

1. What was the **MOST** recent (**check the CTC cards No.1&2**)

      c) CD4 count ………….(indicate the date taken)

      d) Hb (most recent)………….(indicate the date taken)

2. Does this child receive ART?   □ 1. Yes   □ 2. No

3. What combination of medication is the child receiving?

6) AZT+3TC+NVP
7) d4T+3TC+NVP
8) ABC+3TC+NVP
9) AZT+3TC+EFV
10) ABC+3TC+EFV

4. Please go back to 4 days ago, how many ARV pills did the child take in the morning

/afternoon/ night of each of the following days? What time did he/she take?

	Medicine	Morning	Afternoon	Evening
Yesterday		#...........at……..	#...........at……..	#...........at……..
2 days ago		#...........at……..	#...........at……..	#...........at……..
3 days ago		#...........at……..	#...........at……..	#...........at……..
4 days ago		#...........at……..	#...........at……..	#...........at……..

5. What is the highest reached HIV clinical Stage of the child? (Check the CTC cards)

Appendix 5: Research questionnaire - Swahili version (cRCT - Follow up)

DODOSO LA UTAFITI   Tarehe__/__/___   Namba l_l-l__l__l__l

Kichwa cha utafiti: **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za**

afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania

Jina la msaili:……………………   Jina la kituo cha afya…..…………...

Namba ya kadi/CTC ………………   Jina la mtoto (innitials)………………

A. Taarifa kuhusu Mtoto husika

4. Umri (miezi) ... ...

5. Jinsia   □ 1. Me   □ 2. Ke

B. Historia ya lishe

I. Lishe ya mtoto

3. Je mtoto huwa anakula chakuna cha aina nyingine mara ngapi?

□ Mchana………□ Usiku………□ Jumla ……..

II. Kipimo cha vyakula mbalimbali

3. Sasa ningependa kukuuliza kuhusu vinywaji alivyokunywa jana huyu mtoto.

*Weka alama kwenye kinywaji alichotumia **jana***

a. Maziwa kopo, au ya wanyama

b. Juisi ya matunda iliyotengenezwa nyumbani

c. Juisi ya kiwandani

4. Je ni chakula gani kati ya vifuatavyo mtoto huyu alikula jana mchana na usiku?

Weka alama kwenye kundi la chakula alichokula

a. Mkate, ugali, wali au viazi

b. Boga, karoti, viazi vitamu

c. Viazi vitamu, mihogo

d. Mboga za majani kama spinachi, mchicha, kebichi

e. Maembe, papai

f. Matunda mengine, au mboga za majani

g. Nyama nyekundu (ya ngombe, mbuzi, kondoo)

h. Nyama nyeupe (nguruwe, kuku, bata)

i. Samaki

j. Mayai, ………….

k. Karanga, maharage, alizeti………….

l.   Maziwa mtindi, jibini, ………………

m. Siagi, mafuta ya samaki …………….

n.   Vyakula vinginevyo ……………………

3. Mchanganuo wa mlo wa mtoto siku ya jana

	Muda	Aina/jina la chakula, kinywaji, kitafunwa	Kipimo (Bakuli, sahani, Kikombe)
Asubuhi			
Mchana			
Jioni			
Usiku			

4. Maandalizi ya chakula na usafi
3.   Je kwa siku ya jana mtoto huyu alikunywa maji yaliyochemshwa?
   1. Ndiyo   2. Hapana
4.   Je kwa siku ya jana, motto huyu alikula matunda yaliyosafishwa?
   1. Ndiyo   2. Hapana
3. Je Mtoto huyu alikula chakula kilichoandaliwa siku hiyo hiyo?
    1. Ndiyo   2. Hapana

D. Hostoria ya magonjwa nyemelezi ambukizi na afya ya mtoto
3.   Katika mwezi mmoja uliyopita, Je, mtoto huyu ameshawahi kuugua magonjwa

yafuatayo?   (mara ngapi?)

   a. Kikohozi,/ Kupata shida ya kupumua   (... ... ...)

   b. Kuhara   (... ... ...)

   c. Kifua kikuu   (... ... ...)

   d. Malaria   (... ... ...)

4.   Katika mwezi mmoja uliyopita ni mara ngapi mtoto amelazwa hospitali? ... ...

E. Uchunguzi wa mwili (msaili atamuangalia na kumpima mtoto):

    a). Uzito(gm) ... ...

    b). Urefu (cm) ... ...

    c). MUAC (cm) ... ...

F. Maswali maalumu kwa CTC na ART

7. Katika mahudhurio ya mwisho ya CTC, nini ilikuwa

    a). CD4 ……..... ... ...   Tarehe………………..

    b). HB... ... ...   Tarehe………………..

8. Je mtoto amefikia hatua gani ya juu zaidi ya ugonjwa wa UKIMWI? *HIV clinical stage*……………

9. Je, mtoto huyu anapata Dawa za kupunguza makali ya virusi vya UKIMWI (ARV)?

    □ 1. Ndiyo   □ 2. Hapana

10. Mtoto huyu anatumia mchanganyiko gani wa ART?
    6. AZT+3TC+NVP
    7. d4T+3TC+NVP
    8. ABC+3TC+NVP
    9. AZT+3TC+EFV
    10. ABC+3TC+EFV

11. Tafadhali fikiria siku NNE za nyuma, ni vidonge/dozi ngapi vya ARV mototo huyu alikunywa asubuhi/mchana/jioni? Ni muda gani alitumia?

	Asubuhi	Jioni/Usiku
Jana	vidonge...........saa……..	vidonge...........saa……..
Juzi (siku 2 nyuma)	vidonge...........saa……..	vidonge...........saa……..
Mtondo (siku 3 nyuma)	vidonge...........saa……..	vidonge...........saa……..
Mtondogoo (siku 4 nyuma)	vidonge...........saa……..	vidonge...........saa……..

Appendix 6: Interview guide for pre-test

Interview guide

Participants: Twenty pairs of caregivers and their HIV-positive children aged between six months and five years will participate for pre-test of the study. They will be selected from the HIV Care and Treatment Centers (CTCs) also included in the main study.

Principal Investigator: We would like you (caregivers and your children) to participate in the interview for pre-testing the questionnaire of a research titled "**Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania**". First, we would like you to answer questions from the structured questionnaire first. Then, we will interview you on the contents of the questionnaire.

Time: Time for the whole process is about forty-five minutes.

Place of interview: Doctor's rooms in the selected CTC to ensure privacy.

Questionnaire: On completion of the interview, the research assistant will collect the questionnaires and put them in the empty envelope.

Memo: The interview will not be recorded. The memo taken during the interview will be kept confidential and it will be used to make necessary changes to the questionnaires. The memo will be destroyed on completion of the study.

Questions:
1. Was each question easy to follow/hear?
2. Were there any questions you didn't understand? If yes, which ones?
3. Were there any questions you had difficult in answering? If yes, which ones? Do you have any suggestions on how to make them easier?
4. Were there any questions that made you uncomfortable? If yes, which ones?
5. Do you have any other comments?

Appendix 7: Caregivers' information sheet for Pre-test: English version

<u>Information Sheet for Caregivers</u>

Study Title: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Principal Investigators: Masamine Jimba, Sunguya Bruno (The University of Tokyo)
Co-Investigator: David Urassa (Muhimbili University of Health and Allied Sciences)
Dear Sir/Madam,

Thank you very much for your participation in this study.

The objective of this study is to examine the local determinants of undernutrition and effectiveness of nutrition training for mid-level providers on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania.

In this study, we would like to give participants the questionnaire. We will not ask names in this questionnaire. So, the identity of participants will not be disclosed.

If you kindly agree to purpose of this study and participate in the study, you will be interviewed about feeding practices of your child, your household characteristics, and we will take body measurements of your child. What we learn from you help us understand the local causes of undernutrition and design effective intervention to reduce undernutrition for your child and children with similar problems in Tanzania and other countries.

On completion of the interview, we would like to receive your feedback regarding the questionnaire for about 10 minutes. Your feedback will not be recorded. The memo taken during your feedback will be kept confidential and it will be used to make necessary changes to the questionnaires. The memo will be destroyed on completion of the study.

This study is approved by the Research Ethics Committee of the University of Tokyo, and Muhimbili University of Health and Allied Sciences of Tanzania. Your participation for this study is voluntary and you may refuse to answer any question. The interview will take about 30 minutes. Confidentiality is guaranteed and your answer will be part of many other caregivers interviewed so that anonymity is ensured. All the information we obtain will remain strictly confidential and your answer will never be identified. There is no wrong or right answer. Your openness and honest opinions are extremely important. If you have any questions, please do not hesitate to contact ;

<u>Dr. Bruno Sunguya and Prof. Masamine Jimba</u>

Department of Community and Global Health, School of International Health, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan Tel: +81-3-5841-3322

<u>Dr. David Urassa</u>

School of Public Health, Muhimbili University of Health and Allied Sciences (MUHAS), P.O.Box 65489, Dar es Salaam, Tanzania. Tel:+255 754 279553

Appendix 8: Caregivers' information sheet and consent form - Pre-test: Swahili version (MUHAS IRB recommended)

Fomu ya Ridhaa ya Ushiriki

Kichwa cha utafiti; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania.**

Mdhamini; Chuo Kikuu cha Sayansi za Afya na Tiba Muhimbili

Utangulizi;

Fomu hii ya ridhaa ya ushiriki inahusu utafiti wenye kichwa kilichotajwa hapo juu. Ili kuwa na uhakika kuwa umefahamishwa ushiriki wako kwenye utafiti huu, tutakuomba usome (au usomewe) fomu hii. Pia utahitajika kusaini au kuweka alama mbele ya shahidi. Tutakupatia nakala ya fomu hii. Fomu hii inaweza ikawa na maneno ambayo huyaelewi, tafadhali uliza ili ueleweshwe.

Sababu/Maudhui ya utafiti;

Unaombwa kushiriki kwenye utafiti huu ili kutuwezesha kufahamu ukubwa wa tatizo la utapiamlo, vyanzo vyake na matokeo ya mafunzo ya wataalamu wa afya wasaidizi katika kuimarisha afya ya lishe miongoni mwa watoto wenye virusi vya ukimwi.

Ushiriki wako katika utafiti

Iwapo utaridhia kuwepo katika utafiti huu, utaulizwa maswali kutoka kwenye dodoso lililojaribiwa. Ushiriki wako utachukuwa takribani dakika thelathini. Jumla ya wazazi elfu mia nane na watoto wao pia wanahusishwa kwenye utafiti huu. Utafiti huu unafanyika katika kliniki za tiba za watu wanaoishi na virusi vya ukimwi pamoja na kliniki za kawaida za watoto.

Madhara yanayoweza kutokea.

Utafiti huu unaweza kuuliza maswali kuhusu maisha yako, hali yako au ya mototo ya kiafya, ambayo yanaweza kukufanya ujisikie vibaya. Tafadhali kuwa huru kukataa kujibu swali ambalo linaweza kufanya usijisikie vyema.

Faida zinazoweza kupatikana kwa ushiriki wako.

Tutakachojifunza kutoka kwako kitakuwa na manufaa kwa Tanzania na dunia kwa ujumla. Matokeo ya utafiti yatatumika kwa ajili ya kuanzisha mikakati ya kusaidia lishe za watoto wanaoishi na virusi vya ukimwi. Pia tutaweza kushauri kuingizwa kipengele cha lishe kwenye matibabu ya watoto wanaoishi na virusi vya ukimwi.

Kama utachagua kutoshiriki

Uko huru kuchagua kutoshiriki katika utafiti huu, hii haitaathiri kwa namna yoyote ile huduma ya matibabu na afya unayoyapata kutoka kliniki hii.

Utunzaji wa siri; Tutayalinda maelezo yote utakayoyatoa pamoja na ushiriki wako katika utafiti kadri ya uwezo wetu wote. Hautatajwa jina katika ripoti yoyote. Mtafiti mkuu ataweza kuangalia rekodi yako ya utafiti. Hulazimiki kujibu swali ambalo hutaki kulijibu na unaweza kuomba maelezo ya ziada ili kuelewa zaidi maudhui ya swali. Mahakama ya sheria itaweza kuomba rekodi ua usaili ionyehwe kwa watu maalumu ila hili hutokea mara chache. Siku za mbeleni, tutaweza kukufuatilia ili kujua hali yako nay a motto kiafya na lishe. Tutaweza kukutafuta kwa kutumia simu, barua au anwani ya nyumbani kama bado utakubali kushiriki katika utafiti.

Iwapo una tatizo ama swali jingine

Iwapo utakuwa na swali au tatizo lolote linalohusu ushiriki wako katika utafiti huu, tafadhali wasiliana na Dr. David Urassa kwa simu namba 0744 279553. Iwapo utakuwa na tatizo zaidi la kiafya, tutaweza kushauri uchunguzi zaidi pamoja na rufaa.

Makubaliano ya kujitolea

Waraka hapo juu unaelezea faida, madhara, taratibu zitakazotumika katika utafiti wenye kichwa; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania**, umesomwa na kuelezwa kwangu. Nimepewa nafasi ya kuuliza maswali na kujibiwa kadri nilivyotaka. Ninaridhia kushiriki katika utafiti huu kwa kujitolea.

Tarehe…………………………   Saini au alama ya dole gumba la mshiriki……………..

Kama mshiriki hawezi kusoma mwenyewe, shahidi anapaswa kusaini hapa

Nilikuwepo wakati faida, madhara, na taratibu za utafiti zikisomwa kwa mshiriki. Maswali yote yalijibiwa na mshiriki ameridhia kushiriki katika utafiti huu

Tarehe……………………… Saini ya shahidi…………………………………………..

Nathibitisha kuwa madhumuni, faida, madhara, na taratibu zote za ushiriki wa utafiti huu zimeelezwa kwa mshiriki aliyetajwa hapo juu.

Appendix 9: Informed consent for caregivers - Pre-test: English version

Informed Consent Form for Caregivers

To: The Dean of Graduate School of Medicine, The University of Tokyo

Research title: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Principle investigator: Masamine Jimba, Sunguya Bruno (The University of Tokyo)

Co-Investigator: David Urassa (Muhimbili University of Health and Allied Sciences)

I, after reading and having been explained to me the information of this study, I understand what is expected me in this study.

I understand:

1. The purpose and procedure of the study

2. The content of the questionnaire

3. That I will not be placed under any harm of discomfort

4. That I may refuse to answer any question if I don't want to answer

5. That I can withdraw from the study at any time without giving a reason

6. That I can withdraw from the study at any time (during or after study) without any harm or without in any way affecting the health service I receive

7. That any information I provide will be strictly treated in a confidential manner that I will not be identified in the reporting of the result

…………………………………..   ………………………………………….

Date   Signature or fingerprint of the person

                                                                who received the consent

If you have any questions, you can feel free to contact:

Dr. Bruno Sunguya, Prof. Masamine Jimba

Department of Community and Global Health, School of International Health, Graduate School of Medicine, The University of Tokyo

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan   Tel: +81-3-5841-3322

Dr. David Urassa

Dean, School of Public Health, Muhimbili University of Health and Allied Sciences, Tanzania. P.O.Box 65489, Tel: +255 754-279-553

Appendix 10: Caregivers' information sheet - Formative and cRCT studies: English version

<u>Information Sheet for Caregivers</u>

Study Title: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Principal Investigators: Masamine Jimba, Sunguya Bruno (The University of Tokyo)

Co-Investigator: David Urassa (Muhimbili University of Health and Allied Sciences)

Dear Sir/Madam,

Thank you very much for your participation in this study.

The objective of this study is to examine the local determinants of undernutrition and effectiveness of nutrition training for mid-level providers on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania.

In this study, we would like to give participants the questionnaire. We will not ask names in this questionnaire. So, the identity of participants will not be disclosed.

If you kindly agree to purpose of this study and participate in the study, you will be interviewed about feeding practices of your child, your household characteristics, and we will take body measurements of your child. What we learn from you help us understand the local causes of undernutrition and design effective intervention to reduce undernutrition for your child and children with similar problems in Tanzania and other countries.

On completion of the interview, we would like to receive your feedback regarding the questionnaire for about 10 minutes. Your feedback will not be recorded. The memo taken during your feedback will be kept confidential and it will be used to make necessary changes to the questionnaires. The memo will be destroyed on completion of the study.

This study is approved by the Research Ethics Committee of the University of Tokyo, and Muhimbili University of Health and Allied Sciences of Tanzania. Your participation for this study is voluntary and you may refuse to answer any question. The interview will take about 30 minutes. Confidentiality is guaranteed and your answer will be part of many other caregivers interviewed so that anonymity is ensured. All the information we obtain will remain strictly confidential and your answer will never be identified. There is no wrong or right answer. Your openness and honest opinions are extremely important. If you have any questions, please do not hesitate to contact ;

Dr. Bruno Sunguya and Prof. Masamine Jimba

Department of Community and Global Health, School of International Health, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan Tel: +81-3-5841-3322

Dr. David Urassa

School of Public Health, Muhimbili University of Health and Allied Sciences (MUHAS), P.O.Box 65489, Dar es Salaam, Tanzania. Tel:+255 754 279553

Appendix 11: Caregivers' information sheet and consent form - Formative and cRCT studies: Swahili version (MUHAS IRB recommended)

Fomu ya Ridhaa ya Ushiriki

Kichwa cha utafiti; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania.**

Mdhamini; Chuo Kikuu cha Sayansi za Afya na Tiba Muhimbili

Utangulizi;

Fomu hii ya ridhaa ya ushiriki inahusu utafiti wenye kichwa kilichotajwa hapo juu. Ili kuwa na uhakika kuwa umefahamishwa ushiriki wako kwenye utafiti huu, tutakuomba usome (au usomewe) fomu hii. Pia utahitajika kusaini au kuweka alama mbele ya shahidi. Tutakupatia nakala ya fomu hii. Fomu hii inaweza ikawa na maneno ambayo huyaelewi, tafadhali uliza ili ueleweshwe.

Sababu/Maudhui ya utafiti;

Unaombwa kushiriki kwenye utafiti huu ili kutuwezesha kufahamu ukubwa wa tatizo la utapiamlo, vyanzo vyake na matokeo ya mafunzo ya wataalamu wa afya wasaidizi katika kuimarisha afya ya lishe miongoni mwa watoto wenye virusi vya ukimwi.

Ushiriki wako katika utafiti

Iwapo utaridhia kuwepo katika utafiti huu, utaulizwa maswali kutoka kwenye dodoso lililojaribiwa. Ushiriki wako utachukuwa takribani dakika thelathini. Jumla ya wazazi elfu mia nane na watoto wao pia wanahusishwa kwenye utafiti huu. Utafiti huu unafanyika katika kiliniki za tiba za watu wanaoishi na virusi vya ukimwi pamoja na kliniki za kawaida za watoto.

Madhara yanayoweza kutokea.

Utafiti huu unaweza kuuliza maswali kuhusu maisha yako, hali yako au ya mototo ya kiafya, ambayo yanaweza kukufanya ujisikie vibaya. Tafadhali kuwa huru kukataa kujibu swali ambalo linaweza kufanya usijisikie vyema.

Faida zinazoweza kupatikana kwa ushiriki wako.

Tutakachojifunza kutoka kwako kitakuwa na manufaa kwa Tanzania na dunia kwa ujumla. Matokeo ya utafiti yatatumika kwa ajili ya kuanzisha mikakati ya kusaidia lishe za watoto wanaoishi na virusi vya ukimwi. Pia tutaweza kushauri kuingizwa kipengele cha lishe kwenye matibabu ya watoto wanaoishi na virusi vya ukimwi.

Kama utachagua kutoshiriki

Uko huru kuchagua kutoshiriki katika utafiti huu, hii haitaathiri kwa namna yoyote ile huduma ya matibabu na afya unayoyapata kutoka kliniki hii.

Utunzaji wa siri; Tutayalinda maelezo yote utakayoyatoa pamoja na ushiriki wako katika utafiti kadri ya uwezo wetu wote. Hautatajwa jina katika ripoti yoyote. Mtafiti mkuu ataweza kuangalia rekodi yako ya utafiti. Hulazimiki kujibu swali ambalo hutaki kulijibu na unaweza kuomba maelezo ya ziada ili kuelewa zaidi maudhui ya swali. Mahakama ya sheria itaweza kuomba rekodi ua usaili ionyehwe kwa watu maalumu ila hili hutokea mara chache. Siku za mbeleni, tutaweza kukufuatilia ili kujua hali yako nay a motto kiafya na lishe. Tutaweza kukutafuta kwa kutumia simu, barua au anwani ya nyumbani kama bado utakubali kushiriki katika utafiti.

Iwapo una tatizo ama swali jingine

Iwapo utakuwa na swali au tatizo lolote linalohusu ushiriki wako katika utafiti huu, tafadhali wasiliana na Dr. David Urassa kwa simu namba 0744 279553. Iwapo utakuwa na tatizo zaidi la kiafya, tutaweza kushauri uchunguzi zaidi pamoja na rufaa.

Makubaliano ya kujitolea

Waraka hapo juu unaelezea faida, madhara, taratibu zitakazotumika katika utafiti wenye kichwa; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania**, umesomwa na kuelezwa kwangu. Nimepewa nafasi ya kuuliza maswali na kujibiwa kadri nilivyotaka. Ninaridhia kushiriki katika utafiti huu kwa kujitolea.

Tarehe………………………… Saini au alama ya dole gumba la mshiriki……………...

Kama mshiriki hawezi kusoma mwenyewe, shahidi anapaswa kusaini hapa

Nilikuwepo wakati faida, madhara, na taratibu za utafiti zikisomwa kwa mshiriki. Maswali yote yalijibiwa na mshiriki ameridhia kushiriki katika utafiti huu

Tarehe……………………… Saini ya shahidi………………………………………..

Nathibitisha kuwa madhumuni, faida, madhara, na taratibu zote za ushiriki wa utafiti huu zimeelezwa kwa mshiriki aliyetajwa hapo juu.

Appendix 12: Informed consent for caregivers - Formative and cRCT studies: English version

Informed Consent Form for Caregivers

To: The Dean of Graduate School of Medicine, The University of Tokyo

Research title: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Principle investigator: Masamine Jimba, Sunguya Bruno (The University of Tokyo)

Co-Investigator: David Urassa (Muhimbili University of Health and Allied Sciences)

I, after reading and having been explained to me the information of this study, I understand what is expected me in this study.

I understand:

1. The purpose and procedure of the study

2. The content of the questionnaire

3. That I will not be placed under any harm of discomfort

4. That I may refuse to answer any question if I don't want to answer

5. That I can withdraw from the study at any time without giving a reason

6. That I can withdraw from the study at any time (during or after study) without any harm or without in any way affecting the health service I receive

7. That any information I provide will <u>be strictly</u> treated in a confidential manner that I will <u>not be</u> identified in the reporting of the result

…………………………………..   ………………………………………….

Date   Signature or fingerprint of the person

who received the consent

If you have any questions, you can feel free to contact:

<u>Dr. Bruno Sunguya, Prof. Masamine Jimba</u>

Department of Community and Global Health, School of International Health, Graduate School of Medicine, The University of Tokyo

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan   Tel: +81-3-5841-3322

<u>Dr. David Urassa</u>

Dean, School of Public Health, Muhimbili University of Health and Allied Sciences, Tanzania. P.O.Box 65489, Tel: +255 754-279-553

Appendix 13: Information sheet for participants in focus group discussions: English version

<div align="center">

Information Sheet for Participants

</div>

Study Title: Effectiveness of nutrition training for mid-level providers (MLPs) on feeding practices and nutrition status of HIV-positive children in Tanga, Tanzania

Principal Investigators: Masamine Jimba, Sunguya Bruno (The University of Tokyo)
Co-Investigator: David Urassa (Muhimbili University of Health and Allied Sciences)

Dear Participants,

The objective of this study is to understand the determinants of undernutrition among HIV-positive children. Your child and/or you were selected for this study participation, because your child is under the care for this disease and you are his/her caregiver. If you agree to proceed with the study, we would like to conduct the focus group discussion and in-depth interview with you. The discussions are related to causes of undernutrition and feeding practices for your child and other children with similar condition. What we learn from your child and you will contribute to improve the nutrition status and feeding practices of HIV-positive children in Tanga and other regions in Tanzania.

1. Your participation is completely voluntary.
2. The discussion will be recorded for data analysis, and will be totally deleted after analysis.
3. The discussion will take between 45 minutes and 60 minutes.
4. You can refuse to answer any questions if you do not want to.
5. You may withdraw from the study at any time (during or after study) without any harm.
6. All the information about your child and you provide will be strictly treated in a confidential manner that you will not be identified in the reporting of the results.

This study is funded by Department of Community and Global Health, The University of Tokyo. You may ask any questions about the study at this time. If you are sure that you have understood what will be required for you and are willing to participate in this study, please sign on the next sheet. Thank you very much for your kind cooperation.

Date: /   /

Contact:

Dr. Bruno Sunguya and Prof. Masamine Jimba

Department of Community and Global Health, School of International Health, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan Tel: +81-3-5841-3322

Dr. David Urassa

School of Public Health, Muhimbili University of Health and Allied Sciences (MUHAS), P.O. Box 65489, Dar es Salaam, Tanzania. Tel: +255 754 279553

Appendix 14: Information sheet for participants in the focus group discussions: Swahili version (MUHAS IRB

Fomu ya Ridhaa ya Ushiriki

Kichwa cha utafiti; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania.**

Mdhamini; Chuo Kikuu cha Sayansi za Afya na Tiba Muhimbili

Utangulizi;

Fomu hii ya ridhaa ya ushiriki inahusu utafiti wenye kichwa kilichotajwa hapo juu. Ili kuwa na uhakika kuwa umefahamishwa ushiriki wako kwenye utafiti huu, tutakuomba usome (au usomewe) fomu hii. Pia utahitajika kusaini au kuweka alama mbele ya shahidi. Tutakupatia nakala ya fomu hii. Fomu hii inaweza ikawa na maneno ambayo huyaelewi, tafadhali uliza ili ueleweshwe.

Sababu/Maudhui ya utafiti;

Unaombwa kushiriki kwenye utafiti huu ili kutuwezesha kufahamu ukubwa wa tatizo la utapiamlo, vyanzo vyake na matokeo ya mafunzo ya wataalamu wa afya wasaidizi katika kuimarisha afya ya lishe miongoni mwa watoto wenye virusi vya ukimwi.

Ushiriki wako katika utafiti

Iwapo utaridhia kuwepo katika utafiti huu, utaulizwa maswali kutoka kwenye dodoso lililojaribiwa. Ushiriki wako utachukuwa takribani dakika thelathini. Jumla ya wazazi elfu mia nane na watoto wao pia wanahusishwa kwenye utafiti huu. Utafiti huu unafanyika katika kliniki za tiba za watu wanaoishi na virusi vya ukimwi pamoja na kliniki za kawaida za watoto.

Madhara yanayoweza kutokea.

Utafiti huu unaweza kuuliza maswali kuhusu maisha yako, hali yako au ya mototo ya kiafya, ambayo yanaweza kukufanya ujisikie vibaya. Tafadhali kuwa huru kukataa kujibu swali ambalo linaweza kufanya usijisikie vyema.

Faida zinazoweza kupatikana kwa ushiriki wako.

Tutakachojifunza kutoka kwako kitakuwa na manufaa kwa Tanzania na dunia kwa ujumla. Matokeo ya utafiti yatatumika kwa ajili ya kuanzisha mikakati ya kusaidia lishe za watoto wanaoishi na virusi vya ukimwi. Pia tutaweza kushauri kuingizwa kipengele cha lishe kwenye matibabu ya watoto wanaoishi na virusi vya ukimwi.

Kama utachagua kutoshiriki

Uko huru kuchagua kutoshiriki katika utafiti huu, hii haitaathiri kwa namna yoyote ile huduma ya matibabu na afya unayoyapata kutoka kliniki hii.

Utunzaji wa siri; Tutayalinda maelezo yote utakayoyatoa pamoja na ushiriki wako katika utafiti kadri ya uwezo wetu wote. Hautatajwa jina katika ripoti yoyote. Mtafiti mkuu ataweza kuangalia rekodi yako ya utafiti. Hulazimiki kujibu swali ambalo hutaki kulijibu na unaweza kuomba maelezo ya ziada ili kuelewa zaidi maudhui ya swali. Mahakama ya sheria itaweza kuomba rekodi ua usaili ionyehwe kwa watu maalumu ila hili hutokea mara chache. Siku za mbeleni, tutaweza kukufuatilia ili kujua hali yako nay a motto kiafya na lishe. Tutaweza kukutafuta kwa kutumia simu, barua au anwani ya nyumbani kama bado utakubali kushiriki katika utafiti.

Iwapo una tatizo ama swali jingine

Iwapo utakuwa na swali au tatizo lolote linalohusu ushiriki wako katika utafiti huu, tafadhali wasiliana na Dr. David Urassa kwa simu namba 0744 279553. Iwapo utakuwa na tatizo zaidi la kiafya, tutaweza kushauri uchunguzi zaidi pamoja na rufaa.

Makubaliano ya kujitolea

Waraka hapo juu unaelezea faida, madhara, taratibu zitakazotumika katika utafiti wenye kichwa; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania**, umesomwa na kuelezwa kwangu. Nimepewa nafasi ya kuuliza maswali na kujibiwa kadri nilivyotaka. Ninaridhia kushiriki katika utafiti huu kwa kujitolea.

Tarehe………………………… Saini au alama ya dole gumba la mshiriki……………..

Kama mshiriki hawezi kusoma mwenyewe, shahidi anapaswa kusaini hapa

Nilikuwepo wakati faida, madhara, na taratibu za utafiti zikisomwa kwa mshiriki. Maswali yote yalijibiwa na mshiriki ameridhia kushiriki katika utafiti huu

Tarehe……………………… Saini ya shahidi………………………………………..

Nathibitisha kuwa madhumuni, faida, madhara, na taratibu zote za ushiriki wa utafiti huu zimeelezwa kwa mshiriki aliyetajwa hapo juu.

Appendix 15: Information sheet for participants in the nutrition training of MLPs: Swahili version (MUHAS IRB)

Fomu ya Ridhaa ya Ushiriki

Kichwa cha utafiti; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania.**

Mdhamini; Chuo Kikuu cha Sayansi za Afya na Tiba Muhimbili

Utangulizi;

Fomu hii ya ridhaa ya ushiriki inahusu utafiti wenye kichwa kilichotajwa hapo juu. Ili kuwa na uhakika kuwa umefahamishwa ushiriki wako kwenye utafiti huu, tutakuomba usome (au usomewe) fomu hii. Pia utahitajika kusaini au kuweka alama mbele ya shahidi. Tutakupatia nakala ya fomu hii. Fomu hii inaweza ikawa na maneno ambayo huyaelewi, tafadhali uliza ili ueleweshwe.

Sababu/Maudhui ya utafiti;

Unaombwa kushiriki kwenye utafiti huu ili kutuwezesha kufahamu ukubwa wa tatizo la utapiamlo, vyanzo vyake na matokeo ya mafunzo ya wataalamu wa afya wasaidizi katika kuimarisha afya ya lishe miongoni mwa watoto wenye virusi vya ukimwi.

Ushiriki wako katika utafiti

Iwapo utaridhia kuwepo katika utafiti huu, utaulizwa maswali kutoka kwenye dodoso lililojaribiwa. Ushiriki wako utachukuwa takribani dakika thelathini. Jumla ya wafanyakazi wa kada ya kati (Midlevel providers) wanahusishwa kwenye utafiti huu.

Madhara yanayoweza kutokea.

Utafiti huu utauliza maswali kuhusu uelewa wako katika maswala ya lishe na huduma kwa wagonjwa wa VVU, ambayo yanaweza kukufanya ujisikie vibaya. Tafadhali kuwa huru kukataa kujibu swali ambalo linaweza kufanya usijisikie vyema.

Faida zinazoweza kupatikana kwa ushiriki wako.

Tutakachojifunza kutoka kwako kitakuwa na manufaa kwa Tanzania na dunia kwa ujumla. Matokeo ya utafiti yatatumika kwa ajili ya kuanzisha mikakati ya kusaidia lishe za watoto wanaoishi na virusi vya ukimwi. Pia tutaweza kushauri kuingizwa kipengele cha lishe kwenye matibabu ya watoto wanaoishi na virusi vya ukimwi.

Kama utachagua kutoshiriki

Uko huru kuchagua kutoshiriki katika utafiti huu, hii haitaathiri kwa namna yoyote ile mafunzo utakayopewa katika semina hii.

Utunzaji wa siri; Tutayalinda maelezo yote utakayoyatoa pamoja na ushiriki wako katika utafiti kadri ya uwezo wetu wote. Hautatajwa jina katika ripoti yoyote. Mtafiti mkuu ataweza kuangalia rekodi yako ya utafiti. Hulazimiki kujibu swali ambalo hutaki kulijibu na unaweza kuomba maelezo ya ziada ili kuelewa zaidi maudhui ya swali. Mahakama ya sheria itaweza kuomba rekodi ua usaili ionyehwe kwa watu maalumu ila hili hutokea mara chache. Siku za mbeleni, tutaweza kukufuatilia ili kujua hali yako nay a motto kiafya na lishe. Tutaweza kukutafuta kwa kutumia simu, barua au anwani ya nyumbani kama bado utakubali kushiriki katika utafiti.

Iwapo una tatizo ama swali jingine

Iwapo utakuwa na swali au tatizo lolote linalohusu ushiriki wako katika utafiti huu, tafadhali wasiliana na Dr. David Urassa kwa simu namba 0744 279553. Iwapo utakuwa na tatizo zaidi la kiafya, tutaweza kushauri uchunguzi zaidi pamoja na rufaa.

Makubaliano ya kujitolea

Waraka hapo juu unaelezea faida, madhara, taratibu zitakazotumika katika utafiti wenye kichwa; **Matokeo ya mafunzo ya lishe kwa watendaji wasaidizi wa kada za afya kwenye tabia na hali ya lishe kwa watoto wanaishi na VVU- Tanga, Tanzania**, umesomwa na kuelezwa kwangu. Nimepewa nafasi ya kuuliza maswali na kujibiwa kadri nilivyotaka. Ninaridhia kushiriki katika utafiti huu kwa kujitolea.

Tarehe………………………… Saini au alama ya dole gumba la mshiriki……………...

Kama mshiriki hawezi kusoma mwenyewe, shahidi anapaswa kusaini hapa

Nilikuwepo wakati faida, madhara, na taratibu za utafiti zikisomwa kwa mshiriki. Maswali yote yalijibiwa na mshiriki ameridhia kushiriki katika utafiti huu

Tarehe……………………… Saini ya shahidi………………………………………..

Nathibitisha kuwa madhumuni, faida, madhara, na taratibu zote za ushiriki wa utafiti huu zimeelezwa kwa mshiriki aliyetajwa hapo juu.

Appendix 16: Ethical approval - The University of Tokyo

倫 理 委 員 会

審 査 結 果 報 告 書

平成25年03月22日

申請者（研究責任者）
国際地域保健学
教授
神馬 征峰 殿

東京大学大学院医学系研究科長・医学部長
宮園 浩平

審査番号　　10071

研究課題　　タンザニア・タンガ州における中級医療職への栄養トレーニングがHIV陽性の小児
　　　　　　の摂食行動と栄養状態に及ぼす効果

上記研究計画を平成25年03月18日の委員会で審査し下記のとおり判定しました。
ここに通知します。

判　定	
○承認する	条件付きで承認する
変更を勧告する	承認しない
該当しない	

Appendix 17: Ethical and grant approval - Muhimbili University of Health and Allied Sciences (MUHAS)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS

P.O. BOX 65001
DAR ES SALAAM
TANZANIA.

Website: http://www.muhas.ac.tz

Tel: +255-022-2150302/6 Ext: 1016
Telefax:+255-022-2152489
E-mail: drp@muhas.ac.tz

REF: MU/DRP/AEC/Vol.XVI/88

14th February, 2013

Dr. David P. Urassa,
Department of Community Health,
School of Public Health and Social Sciences,
MUHAS.

RE: APPROVAL FOR ETHICAL CLEARANCE AND FUNDING FOR A STUDY TITLED "EFFECTIVENESS OF NUTRITION TRAINING FOR MID-LEVEL PROVIDERS ON FEEDING PRACTICES AND NUTRITION STATUS OF HIV-POSITIVE CHILDREN IN TANGA"

Reference is made to the above heading.

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved funding and ethical clearance of the above mentioned study, based on recommendation of the Expedited Review Sub-committee of Senate Research and Publications Committee meeting held on 11th February, 2013. The validity of this ethical clearance is one year effective from 11th February, 2013 to 10th February, 2014.

Funding amounting to Tshs.16,608,800/= (Sixteen million six hundred and eight thousand eight hundred shillings only) is granted for you to proceed with the research. You are advised to liase with the office of the Directorate of Research and Publications to process imprest application and with the Supplies office to effect procurement of essential supplies for your study if any.

You will be expected to provide six monthly progress reports, final project report and publications emanating from this research study upon completion of your study.

Prof. Mainen J. Moshi
CHAIRMAN, SENATE RESEARCH AND PUBLICATIONS COMMITTEE

c.c. Vice Chancellor, MUHAS   -   Your letter (Ref.No.MU/01/1022/0130/21)
c.c. Deputy Vice Chancellor – ARC, MUHAS.
c.c. Dean, School of Public Health and Social Sciences, MUHAS.

Appendix 18: Permission to conduct research in Tanga region

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu:027 2642421
Fax: 027 2647752

E-mail:rastanga@tanganet.
Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
S.L.P 452
TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectineness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa, sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:**MGANGA MKUU WA MKOA**
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

Appendix 19: Permission to conduct reseach in Tanga muniscipality-district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

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Ofisi ya Mganga Mkuu wa (M)
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07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa, sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:MGANGA MKUU WA MKOA

Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

Mo½c

Pongwe, Makorora, Ngamiani na mukanyuni
mmhusini /apewo muhusa ya kufanya utafiti

CHS 09/04/2013

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Appendix 20: Permission to conduct research in Lushoto district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

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Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
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TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa, sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
 Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:**MGANGA MKUU WA MKOA**
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

MNGULWI.MS

for David Kongue.

Appendix 21: Permission to conduct research in Korogwe district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu:027 2642421
Fax: 027 2647752

E-mail:rastanga@tanganet.
Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
S.L.P 452
TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa. sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
 Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:MGANGA MKUU WA MKOA
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

for MNGULWI.MS

Appendix 22: Permission to conduct research in Muheza district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu:027 2642421
Fax: 027 2647752

E-mail:rastanga@tanganet.
Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
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TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa, sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:**MGANGA MKUU WA MKOA**
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

DISTRICT MEDICAL OFFICE
MUHEZA.

Ag.Amo MTZHC
11/4/2013

Appendix 23: Permission to conduct research in Handeni district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu:027 2642421
Fax: 027 2647752

E-mail:rastanga@tanganet.
Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
S.L.P 452
TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of
nutrition training for Mid-level providers on the feeding practise and nutrition status
among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua
kuwa. sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu
wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana
uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa
kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na
miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na
wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za
kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa
kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote
wa awamu za utafiti huu.
 Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:MGANGA MKUU WA MKOA
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

229

Appendix 24: Permission to conduct research in Pangani district

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA WAZIRI MKUU
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu:027 2642421
Fax: 027 2647752

E-mail:rastanga@tanganet.
Unapojibu taja:

Ofisi ya Mganga Mkuu wa (M)
S.L.P 452
TANGA.

07/03/ 2013

KUMB na /RM/R.20/1/61

DR DAVID P. URASSA
P.O.BOX 65489
DAR-ES-SALAAM
TANZANIA

YAH ; KIBALI CHA KUFANYA UTAFITI KATIKA MKOA WA TANGA

Kichwa cha habari hapo juu kinahusika,
Rejea barua yako tarehe 27.02.2013 ya kuomba kufanya utafiti wa :**Effectiveness of nutrition training for Mid-level providers on the feeding practise and nutrition status among HIV positive children in Tanga.**

Nimepitia maelezo ya barua yako na muhtasari ulioambatanishwa kwa kina na kutambua kuwa, sio tu kuwa utafiti huu utaongeza uelewa mpya kwa watumishi wetu pamoja na watu wanaoishi na VVU na UKIMWI kwenye maswaala ya lishe hasa kwa watoto ambao wana uwezekano wa kupata utapia mlo kutokana na VVU na UKIMWI. Lakini pia utazingatia

utafiti utakaofanyika katika vituo mbalimbali ambapo mtapata fursa yakutoa ushauri wa kisomi unaoendana na wakati na unaozingatia zaidi kile kilichojiri kwenye utafiti na miongozo ya lishe. Aidha kama mlivyoeleza utafiti huu ni kwa manufaa ya nchi nzima na wala sio kwa mkoa wa Tanga pekee. Tuna vituo 39 vinavyotoa huduma za dawa za kupunguza makali UKIMWI katika Mkoa wa Tanga.

Kwa barua hii tuna kukaribisha sana kwa utafiti huo na tunakuhakikishia ushirikiano wa kutosha kuanzia ngazi ya uongozi hadi watumishi popote pale mtakapo kwenda wakati wote wa awamu za utafiti huu.
 Wako katika ujenzi wa Taifa

Dr. Selemani Msangi
Mratibu wa kudhibiti UKIMWI (M)
KYN:**MGANGA MKUU WA MKOA**
Nakala ;Katibu Tawala Mkoa, Waganga wakuu wa Wilaya zote 9, Wakuu Wa CTC zote,

MNGULWI.MS
for Dr Korogwe.