

**AN EVALUATION OF A NUTRITION PROGRAM, POSITIVE DEVIANCE
HEARTH INTERVENTION, IN MIGORI COUNTY, KENYA**

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**A THESIS SUBMITTED TO THE SCHOOL OF AGRICULTURE AND
BIOTECHNOLOGY, UNIVERSITY OF ELDORET IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER
OF SCIENCE IN COMMUNITY NUTRITION**

2015

DECLARATION

DECLARATION BY THE CANDIDATE

I declare that this thesis is my original work and has not been presented for a degree in any other university or institution of higher learning. No part of this thesis may be reproduced without prior consent of the author and/or University of Eldoret, Kenya

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DEDICATION

This work is dedicated to my lovely wife Emma, daughter Chloe, brother Henry, sister Orpah and dear parents, Christine and Daniel.

ABSTRACT

Positive Deviance Hearth program is designed to rehabilitate malnourished children, enable the families to sustain their rehabilitation at home on their own and to prevent malnutrition in younger siblings. However, PD Hearth monitoring system in Migori only assesses program rehabilitation, one of the three PD Hearth objectives. There was need for evaluation to measure outcomes of the PD three fold purposes. The objectives of this study were to assess the extent to which PD Hearth intervention rehabilitates malnourished children, determine the level to which PD Hearth enables families to sustain rehabilitation at home on their own, establish the degree to which PD Hearth prevents malnutrition among the younger siblings and ultimately identify the practices which influence PD Hearth outcomes. A pipeline quasi-experimental design and mixed methods were used to collect data and perform statistical analyses. Single stage cluster sampling was used to identify 53 and 54 intervention and comparison families and children in five communities and 36 younger siblings of the children in the intervention. In Migori County weight measurements of the children in the intervention aged 6 to 59 months at admission were retrieved from Family Aids Care and Education Services programme activities reports at the entry, exit and graduation stages. Anthropometric measurements (height and weight) for these children, their younger siblings and comparison children were taken. In addition, research assisted questionnaires were administered to caregivers of the children in the intervention while the community health workers and area chiefs were interviewed using a pretest questionnaire. Using computer programmes WHO Anthro 2005, SAS 9.1 for Windows, SPSS version 16.0 and Microsoft Office Excel 2007 statistical analyses was computed and positivist approach used to make inference of the study findings. A probability value of ≤ 0.05 was considered significant. The findings indicated that PD Hearth program rehabilitated acute malnutrition but not chronic malnutrition and it had a spillover effect in younger siblings. The results also found that increased feeding frequency made the largest unique contribution to weight gain. Therefore, it is expected that the County government of Migori and the cooperating partners will scale up PD Hearth program to prevent acute malnutrition in the County.

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LIST OF ACRONYMS

APHRC: Africa Population Health Research Center

CDC: Center for Disease Control

CHWS: Community Health Workers

CIPP: Context Input Process and Product

The CORE Group: The Child Survival Collaboration and Resource Group Nutrition Working Group

DHMT: District Health Management Team

F/B: Feedback

FACES: Family AIDS Care and Education Services

HAZ: Height-for-Age Z-score

IPA: Integrated Program Area

IYCN: Infant and Young Child Nutrition

KEMRI: Kenya Medical Research Institute

MAM: Moderate Acute Malnutrition

MIYCN: Maternal Infant and Young Child Nutrition

MoH: Ministry of Health

NCHS: National Center for Health Statistics

NACOSTI:	National Commission for Science, Technology and Innovation
NGOs:	Non-Governmental Organizations
ORS:	Oral Rehydration Salts
PD:	Positive Deviance
PDI:	Positive Deviance Inquiry
PSU:	Primary Sampling Units
RCTP:	Research Care and Training Program
SAM:	Severe Acute Malnutrition
SAS:	Statistical Analysis System
SCHMT:	Sub Committee Health Management Team
SPSS:	Statistical Package for the Social Sciences
SSU:	Secondary Sampling Units
UNICEF:	United Nations Children Education Fund
WAZ:	Weight-for-Age Z-Score
WHZ:	Weight-for-Height Z-score
WHO:	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Beneficiary Children: Children on the intervention

Caregivers: Individuals who help children through the activities of their daily living

Community: Group of people who share common values and live in a location

Community Health Workers (CHWs): Volunteer persons in the community who are in charge of the preventive care in the given community health unit.

Current Status: At the time of study

Entry: The first stage in PD Hearth intervention during which children are admitted into the program.

Exit: The second stage in PD Hearth intervention which marks the completion of the hearth sessions.

Follow up: Timely monitoring of the activities learnt in the Hearth sessions for the first two weeks of the Hearth exit awaiting graduation, usually conducted twice a week for two weeks.

Graduation: The final stage in PD Hearth intervention which marks the end of the PD Hearth follow up periods.

Graduation Rate: The percentage of children in PD Hearth intervention who successfully complete the follow up periods.

Hearth Sessions: The second stage in PD Hearth intervention which refers to a common place where 10-12 mothers with malnourished children, four CHWs and a facility health worker meet to make a PD meal. During the sessions, CHWs educate caregivers on the best behaviors practiced by mothers with well-nourished children living in the same low resourced community.

Homoscedasticity: A statistic term indicating a situation in which the dependent variable is the same for all the data

Impact Evaluation: Analysis that measures the net change in outcomes for a particular group of people that can be attributed to a specific program

Intervention: A form of intercession by the program implementers to provide relief to the deprived.

Linearity: Is the assumption in linear regression that the expected value of a dependent variable is a straight line function of each independent variable, holding the others fixed.

Mild Malnutrition: At risk of acute and chronic malnutrition.

Mild Underweight: At risk of moderate underweight

Moderate Acute Malnutrition (MAM): Nutrition indices between -2 and -3 SD or 70th to 79th percentile

Moderate Underweight: Weight-for-Age Z-score between -2 and -3 SD or 70th to 79th percentile

Multicollinearity: A statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated

Nutrition indices: Weight for height or length; weight for age and height for age

Phases of the PD Hearth intervention: Hearth sessions (period between entry and exit); follow up (period between exit and graduation); beyond graduation

Pipeline Children: Children on the Positive Deviance Inquiry list

Pipeline Hearth List: Positive Deviance Inquiry list

Positive Deviance (PD): Best practices.

Positive Deviance Hearth Intervention: An intervention intended to reverse MAM and prevent SAM in children below five years where the CHWs, through a positive deviance inquiry, identify positive deviant mothers with well-nourished children and negative deviant mothers with malnourished children. The negative deviant caregivers are brought together in a Hearth set up to prepare a PD meal for their malnourished children. The PD meal is prepared based on the best care practices identified from the positive deviant mothers.

Positive Deviance Inquiry: The baseline survey on anthropometry and caregiver practices carried out before initiating a PD Hearth intervention to identify intervention children, pipeline children and positive deviance behaviors from the positive deviant mothers.

Positive Deviance Inquiry List: List containing the baseline values of children obtained during Positive Deviance Inquiry

Rehabilitation: Treatment

Younger Sibling: The immediate brother or sister to the child on the PD Hearth intervention

Severe Acute Malnutrition (SAM): Nutrition indices below -3 SD or 80th percentile

Sustained Rehabilitation: Continued treatment

ACKNOWLEDGEMENTS

I acknowledge the efficient and tireless academic support of my two supervisors, Dr. Gertrude Were and Prof. J. Wanjiku Khamasi, which enabled timely completion of this study. I further acknowledge the support of Mr. Emmanuel Asanyo Onyancha, Nutritionist KEMRI-FACES/RCTP Programme Nyatike; Benard Odhiambo, Community Health Worker Maroo; Sussan, Community Health Worker Thimlich; Geoffrey, World Vision Nutrition Officer Kegonga-Ntimaru IPA; World Vision Nutrition Officer-Aphia Plus; World Vision Nutrition Officer Nyatike IPA and all the care provider officers who facilitated nutrition assessment. I also acknowledge Beldon Anino, John Anino, Erick Anino and Joshua Nkomo for their relentless material and emotional support through the study. Lastly, I acknowledge the care granted to me by my esteemed classmates and friends.

CHAPTER ONE

INTRODUCTION

1.0. Overview

This chapter provides details of the background of the study.

1.1 Background

Childhood malnutrition is a serious worldwide problem (Le Roux, Le Roux, Comulada, Desmond & Mbewu, 2010). Nearly 195 million children are stunted and 125 million are underweight due to inadequate nutrition (UNICEF, 2009). Child malnutrition is attributed to 3.5 million mortality cases every year for under-five year old children (Le Roux *et al.*, 2010). In addition, childhood malnutrition causes a third of the disease burden for the world's under-five year old children each year (Bentley, Wasser & Creed-Kanashiro, 2011). In 1990's childhood malnutrition dropped globally, however, during this time, the prevalence of undernourished children in Africa increased (Piroska & Bullen, 2011). In Kenya, 26% of children under-five years are stunted and 8% are severely stunted; 4% suffer from wasting and 1% from severe wasting, 11% from underweight and 2% from severe underweight (KDHS, 2014). Similarly, KDHS (2014) indicates that 8.6% and 1.6% of children under-five years in Migori County are moderately and severely underweight. In addition, 10.1% and 26.4% are severely and moderately stunted while 4.0% and 0.9% are moderately and severely wasted.

A moderately underweight child has four times and five times higher risks of dying of respiratory infections, malaria and diarrhea than a child with normal weight (Le Roux *et*

al., 2010). This is because the resulting effects of childhood malnutrition include weakened immune functioning (Le Roux *et al.*, 2010). This increases susceptibility to infection amongst the under-five year old children (Nti & Lartey, 2007). The most notable infections following the weakened immune system include the respiratory and gastro intestinal infections which lead to increased child mortality (Le Roux *et al.*, 2010; UNICEF, 2008). Prolonged child underweight leads to behavior problems and poor school achievement (Talbert *et al.*, 2012).

Le Roux *et al.* (2010) established that recovery from malnutrition occurs with improvement in children's diets. These include conforming closely to the recommended maternal, infant and young child nutrition practices, exclusive breastfeeding and intake of the appropriate food proportions. However, the community acceptance of the right feeding practices is hampered by limited information and insufficient resources (Bradely, Curry, Ramadhan & Rawe, 2009) which influence nutrition intervention programs. Bradely *et al.* (2009) further revealed that due to the limited resources, nationwide alleviation of malnutrition cannot be carried out. But as stated by Marsh, Schroder, Dearden, Sternin, and Sternin (2009), governments and NGOs officials are determined to alleviate malnutrition using time and cost effective nutrition education at the health facilities and community meetings. However, Peacock, Konrad, Watson, Nickel, and Muhajarine (2013) found that the latter is not sustained after the program completion. Instead Le Roux *et al.* (2010) identified Positive Deviance (PD) Hearth intervention as the most appropriate program to manage malnutrition.

According to McNulty and The CORE Group (2005)

A Positive Deviance Hearth intervention is a home and neighborhood-based nutrition program for children who are at risk for protein-energy malnutrition in developing countries. The program uses the 'Positive Deviance' approach to identify those behaviors practiced by the mothers or caretakers of well-nourished children from poor families and transfers such positive practices to others in the community with malnourished children. The 'Hearth' or home is the location for the nutrition education and rehabilitation sessions (p. 4).

The PD Hearth intervention follows a community model structure (McNulty & The CORE Group, 2005) which is made of Positive Deviance Inquiry (PDI), Hearth sessions, follow up and graduation as shown in Fig.1. In this study the outcomes of PD Hearth intervention in Migori County were evaluated in the children in the intervention, at the exit of Hearth sessions, follow up and beyond graduation. A comparison group of children were drawn from the PDI list to provide an indicator of what happened in the absence of the intervention (McNulty & Pambudi, 2008a). Younger siblings of the children on the intervention were also included in this study to determine the influence of PD Hearth intervention in the intervention family.

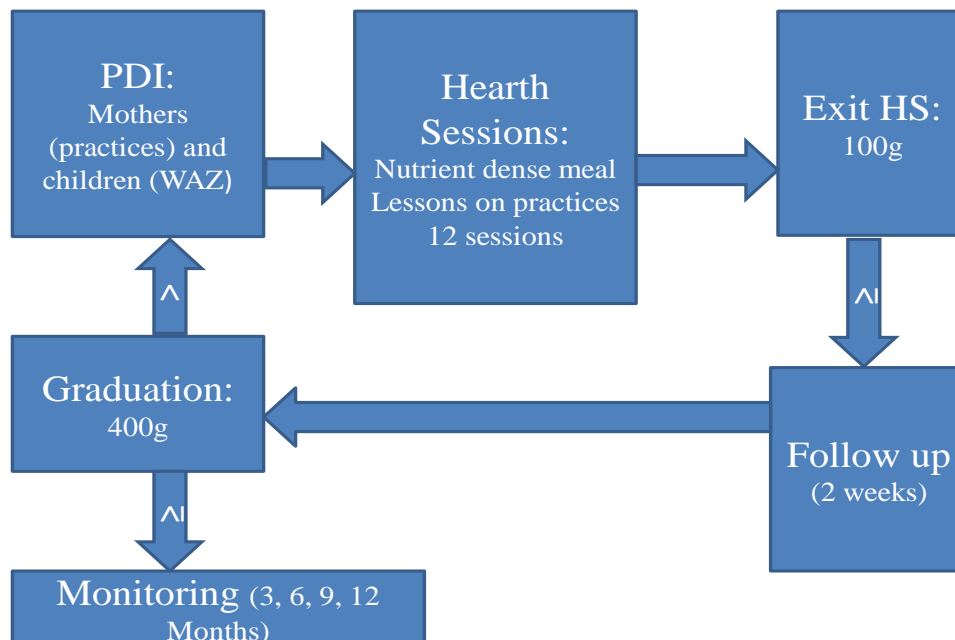


Fig. 1 Stages in PD Hearth (Modified from the CORE Group, 2005)

PD Hearth intervention has enabled the Migori Sub-County Health Management Teams (SCHMTs) to lower the malnutrition management costs and establish nutrition interventions without much reliance on collaborators financial support (F. Songa, Personal Communication, June 24, 2013). Also, the local leaders in the area have welcomed the PD Hearth intervention since it identifies the best practices which the community is already using to address malnutrition and thereby promote ownership of the interventions.

1.2 Statement of the Problem

PD Hearth intervention is designed to rehabilitate malnourished children, enable the families to sustain their rehabilitation at home on their own and to prevent malnutrition in younger siblings. However, PD Hearth monitoring system in Migori only assesses program rehabilitation, one of the three PD Hearth objectives. It tracks Weight for Age (WAZ) for each of the participants upon admission to the program, at the end of the PD Hearth sessions, during the two weeks follow up and at graduation. By tracking only WAZ, it is not possible to investigate wasting and stunting in the children on the PD Hearth intervention. Based on the researcher's experience in implementing PD Hearth programs this can result to increased cases of wasting and stunting of children in the intervention. It can also promote incidences of Severe Acute Malnutrition (SAM), since, when only WAZ is monitored; stunted and wasted children are not devotedly cared for in the intervention. Acute Malnutrition places children at increased risk of morbidity and mortality and is also shown to be related to impaired mental development (KDHS, 2014). Thus, this research intended to evaluate the impact of PD Hearth intervention in Migori County by evaluating all the three nutrition status indicators.

1.3 Objectives

Broad Objective

To evaluate the nutrition programme, PD Hearth intervention, in Migori County, Kenya

Specific Objectives

1. To assess the extent to which PD Hearth program rehabilitates malnourished children

2. To determine the level to which PD Hearth program enables families to sustain the rehabilitation of children in the intervention
3. To investigate the extent to which PD Hearth program prevents malnutrition among the younger siblings
4. To identify practices which influence the PD Hearth outcomes

1.4 Hypothesis

1. H₀: PD Hearth intervention do not improve nutritional outcomes beyond graduation
2. H₀: PD Hearth do not prevent malnutrition in both younger female and male siblings

1.5 Assumptions

1. All the PD sites had maximum participant admission of 12 families
2. All the PD families in the identified study sites participated in the study
3. All the care givers practiced the lessons learnt from the Hearth sessions

1.6 Limitations

1. This study was conducted in 5 locations which are home to 5 communities in Migori County. In each community, only beneficiaries in one of the PD sites were followed.

2. This research followed a pipeline quasi experimental design of the PD Hearth beneficiaries. Thus, it only evaluated the impacts of the PD approach in the children on the intervention.
3. The researcher obtained the entry weight and age measurements of the children on the intervention from the KEMRI FACES/RCTP (2012) programme activities reports.

1.7 Justification

Results from this study will aid the Ministry of Health, non-governmental organizations, development partners, policy makers and researchers to improve effectiveness of the PD Hearth program outcomes and make decisions which ensure PD Hearth rehabilitation sustenance in Migori County. The present study will recommend best practices that influence the outcome of the PD Hearth rehabilitation to the Ministry of Health and influence incorporation of the practices in the nutrition education plan. This study also pointed out practices to the care givers, which when adopted will improve the program impacts, especially, the nutrition outcomes among children in the intervention and their younger siblings. To the development partners and the Migori County Surveillance System Team, the present study will provide vital information on the outcomes of the PD Hearth intervention. This evaluation will further provide recommendations to the policy makers which will help to improve the PD Hearth Monitoring System by incorporating indicators of stunting and wasting. The researchers in the field of health will also benefit from the results of this study since the outlined recommendations will inform future research.

CHAPTER TWO

LITERATURE REVIEW

2.0. Overview

This chapter presents a review of related literature.

2.1 PD Rehabilitate Malnourished Children

2.1.1 PD Hearth's Community Model Approach

Le Roux *et al.* (2010) revealed that, through mentor mothers, the community best practices can be used to alleviate malnutrition. Similarly, role models and positive deviant mothers have been used as vital components of the hearth model for malnutrition recovery in Bangladesh, Haiti, Vietnam, Nigeria and Burkina Faso (Bradley *et al.*, 2009). The same approach has been used in Kenya, especially in Kilifi County to alleviate malnutrition problem (Plan International, 2007). PD Hearth intervention, through its structure of community models provides a sustainable mechanism for alleviating malnutrition in low resource communities (Bolles *et al.*, 2007). The Hearth community model structure is made of certain essential elements for effectiveness of PD Hearth intervention.

1. Positive Deviance Inquiry (PDI)

The first element is conducting PDI using CHWs, project and facility staff. The PDI is a fact finding mission for the project staff and a learning opportunity for the community. McNulty and CORE Group (2005) discovered that “very poor families have certain good practices, which enable them to prevent malnutrition, and these practices can be done by

any family with similar scarce resources (7)". The PDI also helps the program implementers to identify malnourished children to be enrolled in the program and their negative deviant mothers. In addition, it points out the positive deviant practices from positive deviant mothers. These practices are learnt and practiced in the Hearth sessions (McNulty & Pumbadi, 2008a).

2. Community Health Workers and volunteers

The second essential element is to utilize CHWs and community volunteers to carry out the Hearth sessions and the subsequent follow up/home visits (McNulty & CORE Group, 2005). This is because, caregivers learn best with peers who understand their local conditions and customs. Thus, they feel comfortable when the practical Hearth sessions are conducted by the CHWs and the community volunteers.

3. Quick Recuperation

The third element assures quick recovery during the Hearth sessions. Children enrolled in the PD Hearth intervention are de-wormed prior to Hearth sessions (The CORE Group, 2003). In addition, immunizations are up-dated and needed nutrients provided.

4. Hearth sessions

The Hearth sessions are designed such that each caregiver brings a daily contribution of food and/or materials (McNulty & CORE Group, 2005). This motivates the PD Hearth intervention families to learn that they can afford to feed their children healthy and nutritious food. This further gives the community power to implement PD Hearth

intervention without outside material support. With regard to this, the Hearth session menus are designed based on locally available and affordable foods. Indeed, as noted by The CORE Group (2005), this enables families with limited resources to replicate meals in their own homes.

The Hearth session menus are calculated on the supplementation necessary to rehabilitate malnourished children (McNulty & CORE Group, 2005). This provides a nutrient dense meal which enables the children in the intervention to sufficiently recuperate. Thus, PD Hearth meal is not a meal substitute, but an extra supplemental. Once the child is rehabilitated the extra energy and protein rich meal is no longer necessary. However, regular family meals must be nutritious and balanced to ensure rehabilitation sustenance. The Positive Deviant mothers learn how to do this during the Hearth sessions conducted in 12 days within a two week period.

5. Follow up

Two weeks follow up visits after exit from Hearth sessions are included in a PD Hearth program. This provides the average of 21 days of practice recommended by McNulty and CORE Group (2005) to change a new behavior into a habit. Thereafter, the children who attain the recommended weight gain, 200-400g, graduate from the intervention (McNulty & CORE Group, 2005; The CORE Group, 2003). Those who fail to attain the recommended standards repeat the Hearth sessions with the pipeline children on the PDI list.

2.1.2 PD Outcomes in Intervention and Comparison Groups

Impact evaluations on programs based on community Hearth model revealed inconsistent findings. A study Mackintosh, Marsh and Schroder (2002) established no statistically significant differences in WAZ of the children on the PD Hearth intervention and comparison group. McNulty and Pambudi (2008b) found that moderate malnutrition in children on the intervention was 22%, far much lower than 43% in the comparison group, thus, statistically significant. However, wasting was higher in the intervention group than the comparison group at 9.8% and 9.5% respectively.

Earlier studies by Burkhalter and Northrup (1997) found no statistically significant WAZ differences between intervention and comparison group. However, when confounders were controlled using multivariate analysis, larger gains for mild malnourished children was realized. Hendrickson, Dearden, Pachon, AN, and Schroder (2002) and Bracket (2007) found no significant WAZ difference between intervention and comparison group.

2.2 PD Sustain Rehabilitated Children

Three studies reviewed by Pirooska and Bullen (2011) used non randomized trials and sample range of 50 to 192 to establish PD outcomes in children in the intervention and the comparison group. The first study reported positive result; that only a small number of the children on the intervention 6 months after the program suffer from wasting, stunting or underweight. The second study also reported positive significant difference after one month of program implementation. However, the final study showed no significant difference between the control and the intervention group. Though, from the

multivariate analysis, the researchers noted confounding factors which could have affected the findings.

Through impact evaluation of the Philani projects, Le Roux *et al.* (2010) established that Hearth model successfully improves and helps sustain children's nutrition status. Sethi, Kashyap, Aggarwal, Pandey and Kondal (2007) concurred with these findings when they established that fewer intervention infants, as compared to comparison infants in the control villages, were underweight (42.9% vs. 53.7%), wasted (18.6% vs. 31.4%), and stunted (44.3% vs. 56.7%) several months after program termination. Furthermore, the findings by Bolles *et al.* (2002) on the sustenance of the PD outcomes after the program implementation were positive for two studies, with the study conducted after 6 months revealing marginal sustenance of the PD outcomes than the study conducted after one month.

2.3 PD Prevent Malnutrition in Younger Siblings

The Philani PD intervention improved both the nutrition status of the children on the intervention and the non-intervention children in the same families (Le Roux *et al.*, 2010). Mckintosh *et al.* (2002) noted that PD intervention alleviates malnutrition in younger siblings of the participant children with better WAZ compared to the comparison group: age-adjusted mean WAZ -1.82 vs. -2.47 , respectively, $P < 0.021$.

A comparison of three studies conducted using non randomized cross sectional survey of younger siblings and a control group (Piroska & Bullen, 2011) revealed that younger

children on the intervention groups had lower malnutrition rates than the control group. The sample sizes in the three studies ranged from 46 to 128 and were carried in four to five communities. Based on these studies, it is apparent that the age of the participant children and the timing of intervention influence the outcome and successes of the PD approach.

2.4 Practices in PD Interventions

Studies conducted by Nti and Lartey (2006) revealed that care behaviors are linked to the child nutrient intake and health. These care practices include the caregivers' ability to feed responsively, the child's appetite and feeding situation. Thus, together with age of the child and duration after the intervention on influencing the sustenance of the PD approach outcomes, care behaviors also play a significant role.

Previous studies by Mckintosh *et al.* (2002) showed that the feeding practices between the positive deviance and the comparison groups differed significantly. For instance, from the study, 41% of the positive deviance mothers were breastfeeding compared to 20% of the comparison group. In fact, even after controlling possible factors (such as hours mother worked outside the home, age and sex of the beneficiaries) which contributes to PD outcome sustenance using the multiple variables modeling, the PD intervention mothers had significantly better feeding practices. Mackintosh stressed that the mothers in positive deviance interventions have higher ability to recall the recommended infant feeding practices 2 to 5 years after the implementation of the positive deviance practices. However, Schroeder, Pachon, Deardan, Ha, and Lang (2002)

established that there were no statistically significant differences for breastfeeding prevalence in intervention and non-intervention groups.

Lapping *et al.* (2002) stated that PD approach has potential to support malnutrition interventions through advocacy, discovering new skills and refinement of the caregivers' current activities. This means that, unlike the traditional malnutrition approach where the focus is mainly recovery and ensuring a normal nutrition status, PD approach aims to promote multiple behavior changes. However, these behaviors are not monitored; thus, it is hard to measure their impacts after the program intervention.

A systematic review conducted by Piroška and Bullen (2011) concurred with Lapping *et al.* (2002) on the view that positive deviance leads to multiple behaviors change. Piroška and Bullen (2011) revealed that PD approach improves breastfeeding rates, feeding practices, hygiene practices, nutritional status, weight gain and weight for age Z-scores. But as reported by Piroška and Bullen, some studies did not report the statistical significance; thus, they did not conduct a quantitative Meta-analysis on such articles to enhance heterogeneity in outcome variable and for better report quality. Therefore, it cannot be conclusively stated that the PD approach improves all the above identified behaviors and status.

2.5 CIPP Evaluation Model

This study adopted Daniel Stufflebeam's improvement oriented evaluation model (Mathison, 2005) to establish the nutrition status attained and behaviors practiced after graduating from PD Hearth intervention. Context, Input, Process and Product (CIPP)

evaluation was first introduced in 1966 by Daniel Stufflebeam (Mathison, 2005). According to this model, evaluation serves three principal functions; it increases understanding of the phenomenon under review, provides accountability records and fosters improvement. The CIPP evaluation model indicates that though context, input, process and product evaluation are interrelated, they serve distinctive functions with chief emphasis on the improvement function of evaluation.

The paramount function of context evaluation is to identify the strengths and weaknesses of the program. A context in the PD Hearth set up is the communities where the PD Hearth sites are situated and the circumstances leading to their initiation. In most occasions, PD Hearth is initiated when there is over 30% moderate acute malnutrition (MAM) prevalence (McNulty & CORE Group, 2005).

The input evaluation identifies the potential resources, constraints and barriers that need to be taken into account in the process of activating a program. In the PD Hearth set up input includes all the resources brought in by the participants, Ministry of Health and the funding agency. Usually, the participants bring in food stuffs and utensils to be used in the Hearth sessions. They also dedicate their time to the process. MoH brings in the nutritionists, health workers and the community health workers to facilitate the program; whereas, the funding agency facilitates their travel, facilitation and lunch allowances.

The process evaluation is an ongoing check on the implementation of a plan. It gives feedback to staff and managers, guide modification of plans as needed, and assess the extent to which participants accept their roles, and provide a record of how the program

was implemented. Accordingly, the process in PD Hearth Intervention includes the 12 days Hearth sessions which is made up of the best practices identified from the positive deviant mothers through the PDI.

Product evaluation is intended to measure, interpret and judge the attainment of a program. This is done to find out the extent to which the program has met the needs of the group it is intended to serve. In addition, it examines the effects intended and unintended as well as positive and negative outcomes. This can be achieved by use of tests, interviews, observations and case studies. The CIPP evaluation model is holistic and can be carried out at different stages to provide feedback to decision makers and administrators. The expected product in a PD Hearth nutrition program is reduced malnutrition and improved care giver practices.

In the present study, the researcher used product evaluation to assess nutrition status of the children on the intervention to establish the extent to which PD Hearth had reduced malnutrition and sustained its rehabilitation. It also enabled evaluation of the nutrition status of the siblings of the children on the intervention, and the level to which PD Hearth intervention had improved the care giver practices. The evaluation was undertaken at four product levels; improved nutrition status, health and care behaviors, local capacity and community commitment. Interpretation and judgment of these measurements enabled the researcher to establish the extent to which PD Hearth program had met its multi-fold purpose.

2.6 Conceptual Framework

The goal of the PD Hearth intervention in Migori County was to reduce malnutrition through sustained rehabilitation in malnourished children and its prevention in their younger siblings. Thus, the outcomes of the PD intervention in Migori were:

1. Improved nutrition status amongst the beneficiaries,
2. Improved health behaviors of the care givers,
3. Improved local capacity and
4. Community commitment.

These were measured as indicated in Fig. 2 below. In the Fig F/B denotes feedback.

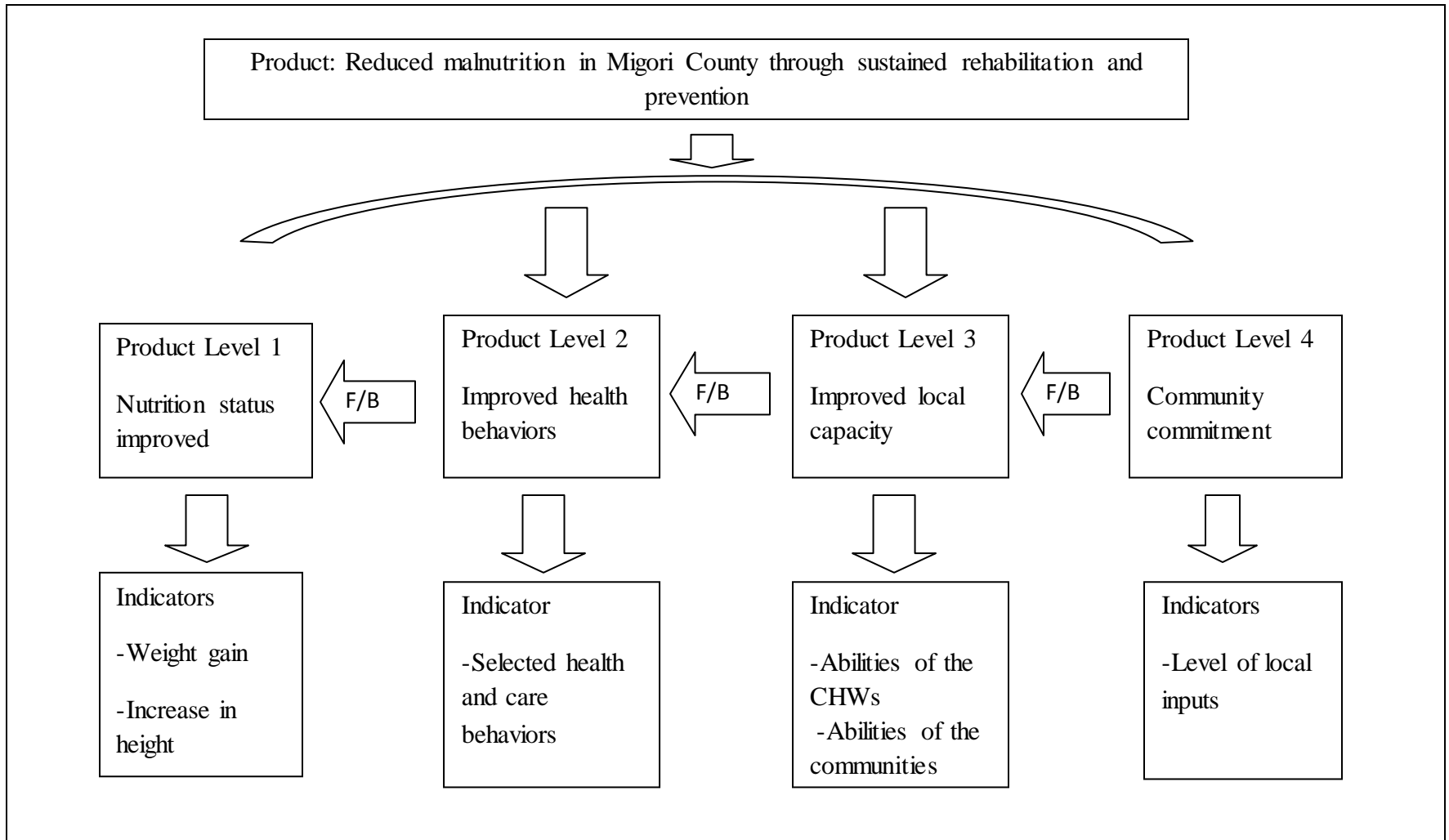


Fig 2: Conceptual Framework Model (Source: Author)

2.7 Summary of Literature and Gaps in Knowledge

In summary, there is ample literature on PD Hearth rehabilitation of underweight in children with moderate acute malnutrition. However, there is limited literature on PD Hearth programs ability to sustain rehabilitation and to prevent malnutrition in younger siblings. This is the gap that this research will fill.

CHAPTER THREE

RESEARCH APPROACHES

3.0 Overview

This chapter gives details of the research approaches used to collect data and to make inference of the findings.

3.1 Research Design

The researcher used a pipeline quasi-experimental design to evaluate the impact of PD Hearth program. A study by Behi and Nolan (1996) used a similar design to provide a detailed comparison of the intervention and the pipeline groups. The research design allows comparison between intervention and non-intervention groups and assesses change over time (Fisher, Laing & Stoeckel, 1998; Fischer & Foreit, 2002). The intervention and the comparison groups in the quasi-experimental design are created on random or systematic allocation of groups though the statistical analyses use the individuals as the basis of comparison. Therefore, quasi-experimental design is used in a number of health care situations where naturally occurring group exists. In the study, the entire group (intervention group) rather than the individual (children in the intervention) received the Hearth intervention, while the entire comparison group (families in the pipeline PD Hearths provided in the PDI list) did not.

3.2 Study Site and Population

The present study was conducted in five communities in Migori County (Appendix 3). These were Maroo, Nyakune, Thimlich, Ntimaru and Kegonga communities. The choice

of the study communities was based on the fact that they were the areas in Migori County where the PD sites had been situated thus the communities were purposively collected. Besides, similar studies carried out to evaluate the impacts of PD intervention in Rural Bangladesh (Parvanta *et al.*, 2007) and North Vietnam (Hendrickson, 2002) and India (Shrocoder *et al.*, 2002) were undertaken in five communities in 2006, 2001 and 2001 respectively. Philani project in South Africa also evaluated PD outcomes in five communities, during the period of 2006-2007 in Johannesburg (Le Roux *et al.*, 2010).

Migori County is located in the South Western part of Kenya (ASDSP, 2014). It borders the United Republic of Tanzania to the South, Narok and Kisii Counties to the East and Homa Bay County to the North. Lake Victoria borders the county to the West. The county is located between latitude $0^{\circ} 24' S$ and $0^{\circ} 40' S$ and Longitude $34^{\circ} E$ and $50^{\circ} E$ (ASDSP, 2014). Migori County has 7 sub-counties and 76 locations which covers an area of 2, 596.5 km² including 478 km² of water surface (ASDSP, 2014). ASDSP (2014) further indicated that the county has an altitude varying between 1,140 m at the shores of Lake Victoria in Nyatike Sub-county to 4,625 m in Uriri Sub-county (ASDSP, 2014).

The total population of Migori County according to 2009 population census was 917 170; 51.4% female and 48.6% male (KDHS, 2008). The population growth rate was estimated at 3.8% per annum (KDHS, 2008) thus the expected population for the county in 2015 was 1 152 165 persons. Luo and Kuria ethnic communities are the residents who live in this area. A number of 'Maragoli'-a subtribe of the Luhya ethnic community and Kisii also live amidst them.

The county has an arable land covering an area of 1800 Km² of which 37% is cultivated for crops (ASDSP, 2014). The soil is fertile and suitable for agricultural activities. The non-arable lands are due to unreliable rainfall and are found in Nyatike and Kuria Sub-counties.

The target population was families which benefitted from the PD interventions from October 2012 to October 2013. From the families children aged 6 to 59 months at PDI who had poor nutrition status, their younger siblings and caregivers were considered. This is because; the PD program admits children from age 6 to 59 months (McNulty & CORE Group, 2005). A comparison group drawn from the PDI list was also studied to provide estimate of what would have happened in the absence of an intervention. The comparison group had similar characteristics to the intervention group and had been considered for the subsequent PD Hearth intervention awaiting the availability of funds. The comparison group assisted to assess the net effect of the program outcomes (Leeuw & Vaessen, 2009). Five CHWs in charge of each of the five community units and 5 area chiefs from each of the locations were also included in the study.

3.3 Sample Size and Procedure

3.3.1 Sample Size

The sample size of the study was 53 families in the intervention from which 53 caregivers and 53 children in the intervention and their 36 younger siblings were studied. A comparison group of 54 PDI response families in the identified five communities were also sampled from which 54 comparison children were studied. Since a hearth session is designed to rehabilitate 10 to 12 malnourished children (The Core Group, 2003) only a

maximum of 60 families could be admitted to five PD programs. However, only 53 children on the intervention met the inclusion criteria and 54 comparison groups were listed in the PDI list. The sample size was consistent with the earlier studies conducted in Haiti and Indonesia by Bolles *et al.* (2002) and McNulty and Pambudi (2008a) which used a sample size of 50 and 62 families to evaluate impacts of PD. Two similar studies conducted in India and Vietnam used sample size of 46 and 50 households correspondingly (McKintosh *et al.*, 2002; Sethi *et al.*, 2007). The area chiefs and the CHWs in charge of each of the five communities were also sampled.

3.3.3 Sampling Procedures

A total of 13 hearth sites had been implemented between the months of October 2012 to October 2013 (FACES Nutritionist, Personal Communications, October 23, 2013). Out of these 11 had been completed to graduation and this formed the sampling frame. Using the single stage cluster sampling method the researcher selected 5 PD sites. In this sampling method all the elements from each of the selected clusters were used thus it was preferred because it is time efficient (Ahmed, 2009). The sampling frame of the hearth sites was readily available and needed less time for listing and implementation.

The PD Hearth sites were sampled as the Primary Sampling Units (PSU) using systematic random sampling since it's easy to draw and execute. A systematic random sample also ensured representativeness of the clusters (PSU) chosen. The five PSUs were chosen by sampling every 2nd PD Hearth sites from the 11 which had been completed to graduation. The sampling interval of 2 was arrived at by dividing the sampling frame of 11 hearth sites by the sample clusters of 5 sites (Fischer *et al.*, 1998). All the secondary

sampling units (SSU) were made up of the PD Hearth intervention families in the chosen 5 PD sites. Families in the comparison group were obtained from the pipeline PD Hearths which were listed in the positive deviance inquiry (PDI) list.

3.3.4 Inclusion and Exclusion Criteria

The inclusion criteria for the intervention group were children aged 6-59 months at PDI who graduated from the program. The inclusion criterion for comparison group was children aged 6-59 months at PDI who were in the pipeline Hearth list.

The exclusion criteria of the Hearth sessions included children who failed to graduate from the program, due to referrals, failure to gain the desired weight and non-commitment by the caregivers.

3.4 Methods, Tools and Procedures

3.4.1 Methods

This study was conducted in the months of December 2013 and January and February 2014. This is because a study in Western Kenya revealed that during these months most mothers can be reached in the households since the farming activities are less (Semproli & Russo, 2007). Also, in the month of December and early January children were on school holidays, thus, could be reached during the time of study. The study was based on the 9 step guidelines for conducting impact evaluation by Network of Networks on Impact Evaluation (NONIE) (Leeuw and Vaessen, 2009). The first 6 steps were useful for methodological guidance and the last 3 assisted in managing the impact evaluation

process. For methodological guidance the researcher identified the type and scope of the intervention; decided on what to be valued; carefully articulated the theories linking interventions to outcomes; addressed the attribution problem; used mixed research methods approach for the logic of comparative advantage of methods and built on existing knowledge relevant to the impact of interventions (Leeuw and Vaessen, 2009). On guidance of managing impact evaluations the researcher determined whether impact evaluation was feasible and worth the cost and ensured front-end planning throughout the study (Leeuw and Vaessen, 2009). The study was carried out using two quantitative data collection methods; nutrition assessment to collect anthropometric data and administering questionnaires to collect information on behaviors practiced beyond graduation. Also, one qualitative method was used; interviewing CHWs and area chiefs.

3.4.2 Research Tools

1. SECA Scale

Weight measurements were taken using the UNICEF approved SECA 150.0 kg scale (SECA, model 8811021659, Germany). This scale was used across the five communities to take the children's weight. The measurements were recorded close to the nearest 0.1 kg. The researcher calibrated the SECA scale to 0.00 using 1 kg sugar after every 5 measurements to enhance precision and accuracy of the measurements as used by Anino, Mugalavai and Kamau (2013).

2. Digital Infant Scale

Weight measurements of the children aged 6 to 12 months were taken to the nearest Ib using digital infant scale since the available digital infant scale was calibrated in Ib. The scale was adjusted to 000.00 reading using a rod of 5 kg.

3. Height Board

Height and length was measured to the nearest 1.0 cm using height boards for children who could stand. The same board was used to measure recumbent length of children who could not “stand up tall” to the nearest 1 cm.

4. Questionnaires

Self-administered questionnaires were used to identify practices that influence PD outcomes (Appendix 1). Questionnaire was the most appropriate tool to collect information on PD related practices since it ensured high response rate at a low cost (Mugenda & Mugenda, 1999). Earlier studies to evaluate impacts of PD Hearth intervention within one year after graduation used questionnaires (McKintosh *et al.*, 2002; McNultry & Pambudi, 2008a). The questionnaire comprised of four sections; demographic data, behavior change, improved local capacity and community participation and empowerment. The demographics section was made up of 6 variables; gender, marital status, age, level of education, work experience and employment status. Behavior change section consisted of 16 questions categorized into four variables; caregiver practices, health seeking behavior, hygiene practices and positive behavior practiced in PD Hearth. Improved local capacity section comprised of 8 questions

corresponding to 1 variable, the local capacity to implement PD Hearth. Ultimately, the last section contained 4 questions to address two variables, the community participation and empowerment. The questionnaire was tested for internal reliability using Cronbach alpha coefficient. Cronbach alpha coefficient above 0.631 was considered sufficient to ensure the questionnaire suitability.

5. Health Records

Health records provided information on the weight measurements and age of the children on the intervention at PD Hearth entry (FACES/RCTP, 2012; 2013).

6. Interview guides

Interview guides provided information on the local capacity and community commitment in PD Hearth intervention. The interview guides comprised of six questions for the CHWs and four questions for the area chiefs (Appendix 2).

3.4.3 Procedures for Data Collection

3.4.3.1 Nutrition Assessment

1. Reviewing Weight Measurements in Health Records

Nutrition assessment of children in the intervention was reviewed in two phases. Weight and age information at the entry and exit stages were obtained from the host health facilities activity files along with weight measurements at the time of PD graduation. This is because one of the responsibilities of MoH as PD Hearth program collaborator is to keep copies of the documents used and developed during the PD program implementation

(The CORE Group, 2003). To ensure consistency in the entry and exit information similar data was obtained from the collaborating NGO program reports. The information helped in establishing the nutrition status at each stage of PD intervention and was used to assess the extent to which PD Health programs rehabilitate malnourished children. The researcher also obtained the PDI list from the facility health records. In the second phase current anthropometry measurements was taken as detailed in the following section.

2. Taking Weight Measurements

Weight measurements were taken using Center for Disease Control (CDC) approved procedures (CDC, 2007). The participants were asked to wear minimal clothing and remove shoes. They were then asked to stand at center of the UNICEF approved SECA scale platform facing the researcher with hands at the sides and looking straight ahead (CDC, 2007). After the participants' were correctly positioned and the readout on the digital SECA scale became stable researcher read and noted weight measurements of each participant. Each participant was weighed three times and the average calculated and recorded.

The digital infant scale was used to weigh children between 6 to 12 months. The scale was activated by turning it on. The caregiver was asked to remove all clothing of infant (except diapers/napping) and outer heavy clothing of children between 12-36 months who could not comfortably stand. After which, the child was placed sitting on the tray of the scale. The weight reading appeared on the display panel. However, weight was read and recorded only after hearing the beep sound.

3. Taking Height Measurement

Height or length measurements were taken using CDC approved procedures (CDC, 2007). The participants were requested to remove shoes. They were asked to stand with heels together, arms to the side, legs straight and shoulder relaxed. Heels, buttocks, scapulae (shoulder blades) and back of the head was against the board. The participants head was then aligned in the Frankfort horizontal plane. This was done by gently tilting the head of the participants up or down to achieve the proper alignment. Also, the participants were instructed to look straight ahead to ensure that the head was on the Frankfort plane. Next, the headboard was lowered with enough pressure to compress the hair so that it rested firmly onto the highest point of the participant's head (CDC, 2007). Just before the measurement was taken, the participants were requested to inhale deeply, hold the breath and keep an erect posture "stand up tall". Keeping the eye level with the hardboard, the researcher read the height measurements. Height measurement for each participant was taken three times and the average calculated.

Length measurement of children who were not able to "stand up tall" was also taken. The enlisted steps for height measurements were followed with the exception that through the help of research assistant the child was laid flat on board with hand on knees to keep legs straight. The feet of the child was flat against foot piece and the research assistants hands cupped over the ears to ensure head is against base of board.

3.4.3.2 Administering questionnaires

The questionnaire was self-administered to each caregiver to identify practices that influence PD outcomes. However, to a mother who was not conversant with English language, the questionnaire was research administered. The researcher was assisted by two local research assistants who were eloquent in native languages spoken in the five communities to interpret the questions and response codes to the non-educated caregivers. The Public Health and Sanitation department recommends a team of three researchers; the researcher and two assistants to carry out nutrition surveys (Kenya National Bureau of Statistics, Ministry of Public Health and Sanitation and UNICEF, 2008).

3.4.3.3 Interviewing CHWs and area chiefs

Face to face interviews were conducted with the CHWs in the five study communities. The interviews helped the researcher to establish the CHWs local capacity to rally for resources and their ability to implement PD Hearth interventions. Similar interviews were conducted with the area chiefs in each of the five communities to find out their commitment and its contribution to PD Hearth intervention outcomes.

3.4.4 Validity and Reliability

Internal validity was ensured through triangulation. The researcher used 3 research methods; nutrition assessments, questionnaire administration and interviewing and 6 tools; SECA scale, height board, infant measuring board, questionnaire and health records to collect data with the hope that together they support the stipulated hypothesis.

On the other hand, external validity was ensured by evaluating PD Hearth program beneficiaries who gained from the Hearth Models real life setting. It was also achieved by following all the cases of the PD Hearth beneficiaries in the selected PD Hearth sites. In addition, the credibility of the findings was attained through consistent literature review; ensuring respondent validation and incorporating feedback from the PD Hearth intervention partners.

Face validity of the measuring instruments was attained by using UNICEF SECA approved scale, height board and easy to fill questionnaire which assured respondents cooperation (Mugenda & Mugenda, 1999). As used by Anino *et al.* (2010) the researcher standardized the scale by using a known weight, 1 kg sugar for SECA scale and a rod of 5 kg after every 5 measurements. The weight and height measurements were taken to the nearest 0.1 kg and 1 cm respectively, and the height measurement read when the eye was leveled with the headboard.

Content validity was achieved by asking questions which reflected the skills and behaviors acquired during the PD Hearth sessions. Construct validity was ensured by designing a questionnaire which measured correlated information. Ultimately, criterion validity was achieved by following the UNICEF approved anthropometry measurement procedures. The measurements were taken three times and the average recorded.

Internal consistency reliability was achieved by paraphrasing some questions in the questionnaire but retaining the response codes. Conversely, test and retest reliability was ensured by pre-testing the questionnaire and training the research assistants.

Research Assistants

Two research assistants with diploma in social studies suggested by FACES/RCTP Program in Nyatike and World Vision Kegonga-Ntimaru were trained by the researcher on Standardized Monitoring and Assessment of Relief and Transition (SMART) Methodology. The criteria for choosing the research assistants were; diploma holders in Community Work with proficiency in local languages and two years' experience in community health work.

Pilot Test

The SECA scale was calibrated and used to take weight measurements of 10 children on the intervention and their younger siblings prior to the study. Ten questionnaires were administered to the PD Hearth intervention families in Thimlich community. These families belonged to a PD Hearth site which was not sampled for the study. The pilot test was important to enable standardization of the questionnaire and familiarize the researcher and the assistants with research tools and the community.

3.5 Data Analysis

The collected data was subjected to statistical analysis using WHO Anthro 2005 Software, SAS 9.1 for Windows 2003, SPSS version 16.0 2007 and Microsoft Office Excel 2007. A probability value of ≤ 0.05 was considered significant.

WHO Anthro 2005 computer program was used to determine the Z-Score values from the anthropometric data (Lapping *et al.*, 2002; WHO, 1995). The resulting Z-Score values

were transferred to Microsoft Office Excel 2007 for generation of percentages and statistical significance by inserting paired and independent sample *t*-test formulas and graphical presentation of the Z-Score findings. Sorting the Z-Scores by cluster, age, sex and nutrition indicators, they were transferred to SAS 9.1 for Windows where univariate analysis was performed to generate means, standard errors (SE) and statistical significance for each of the parameters under study. SPSS version 16.0 was used to generate descriptive statistics, frequencies and means, and non-parametric values for the caregiver responses on behavior change, local capacity and community empowerment. It was also used to perform linear standardized multiple regression modeling and to compare means using both paired sample and independent sample *t*-test.

Comparative analysis using univariate procedure was performed for succeeding PD Hearth phases. Mean WAZ was compared for the children on the intervention at entry and exit, at exit and graduation, at graduation and current status and at entry and current status to estimate the net change in WAZ. Percent number of underweight children at entry and percent number of malnourished children at current status was also used to indicate the extent of rehabilitation. Conversely, correlation was used to find association between the graduation rates and weight gain or change in WAZ. Paired sample *t*-test was performed for each of the comparison parameters.

Comparative analysis using univariate procedure was performed at entry and current status for the comparison children. Differences in means of the children on the intervention and comparison children at entry and current status were used to indicate the

amount of net change in outcomes due to intervention. Percent number of children who were underweight, stunted and wasted at current status was also used to tell the magnitude of rehabilitation sustenance. Independent sample *t*-test was performed for each of the comparison parameters.

Univariate analysis procedure was performed for the beneficiaries' younger siblings. Mean WHZ, WAZ and HAZ were used to tell the siblings nutrition status at current status. Percent number of younger siblings who were underweight, wasted and stunted was also used to show the degree to which PD Hearth prevents malnutrition in younger siblings. Paired sample *t*-test was performed for each of the comparison parameters.

Descriptive statistics were generated for all the variables. Chi square was used to test for significant association of categorical variables such as gender and level of education. In addition, linear standard multiple regression modeling was used to examine how each of the caregiver practices predict weight gain at current status. The model equation shown below was adopted to determine the weight attained at the current status variable.

Model equation

$$y = a + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + \beta X_6 + \beta X_7 + e$$

The qualitative responses were analyzed under two themes, local capacity and community empowerment, depending with the respondents' feedbacks.

3.6 Ethical Approval

A research permit from the National Commission for Science, Technology and Innovation (NACOSTI) was granted in order to carry out this study (Appendix 7). Research approvals from the Office of the County Commissioner and County Education Director in Migori were also granted (Appendix 7). Letters of intent explaining the reason for carrying out the research were sent to both Macalder and Kehancha District Hospitals (Appendix 6). Through the letters, the researcher assured the collaborators of his will to protect the anonymity and confidentiality of the participants and information given. This research was also designed and implemented based on the guidelines for nutrition assessments, data collection, analysis and interpretation in Kenya (Kenya National Bureau of Statistics, Ministry of Public Health and Sanitation and UNICEF, 2008). These included seeking written and verbal consent from the caregivers of the children prior to taking anthropometric measurements (Appendix 5).

CHAPTER FOUR

RESULTS

4.1 Overview

The chapter gives a detailed overview of findings obtained from this study.

4.2 Characteristics of the Respondents under Study

The study evaluated the PD Hearth intervention in children in the intervention and their younger siblings and comparison children drawn from the PDI list. Their characteristics are as presented.

4.2.1. Intervention and Comparison Children

Sixty (60) children were screened and admitted to 5 PD Hearths sites in five communities. More than half (88.3%) (n=53) graduated from the program and were all available at the time of study. On the other hand, 90% (n=54) of the comparison children were available and participated in the study. The mean age at recruitment for PD Hearth participant children (22.3 ± 1.3 months) and comparison children (22.2 ± 1.3 months) were not significantly different ($P= 0.067$). Again, there was no significant difference in their mean age at current status ($P> 0.067$). The mean values for the two groups (children on the intervention and the comparison children) were 28.5 ± 1.0 and 27.7 ± 1.2 respectively. The mean WAZ of the comparison children (-1.15 ± 0.10) at PDI was higher but not statistically significant ($P=0.18$) than that of the PD participating children at entry (-1.34 ± 0.09). However, at current status, WAZ was greater for children on the

intervention group (-0.77 ± 0.09) than their corresponding counterparts (-1.13 ± 0.11) and statistically significant at ($P=0.014$). WHZ was significantly different for the participating children (-0.07 ± 0.14) and their siblings (1.03 ± 0.25 , $P< 0.0001$). However, HAZ and WAZ for the intervention group and their siblings were not significantly different at ($P> 0.08$). More females (58.5% and 57.4%) belonged to both the intervention and comparison groups than males (41.5% and 42.6%) respectively.

4.2.2. Caregivers

All the caregivers for the two groups were mothers. More caregivers (66.7%) in the PD participating group were young mothers aged 18 to 30 years, and 88.5% had primary education with only 11.5% having secondary education. None of the caregivers in the intervention group attained post-secondary education. Similarly, 75.3% of the comparison groups were aged 18-30 years. Like their intervention group counterparts, 80.1% had primary education with only 6.5% attaining secondary education. A small number (13.4%) of these mothers had not attained any level of education. Almost all the mothers (95.7%) in this group were married and only 4.3% were single. As regards employment status, almost equal proportions of the caregivers of children from both the intervention and comparison groups were not employed. Thus, characteristics of caregivers of PD participating children and their comparison counterparts were comparable for marriage and employment status but not comparable for maternal education and background.

4.3 Extent of PD Hearth Program Rehabilitation

4.3.1 Extent of Rehabilitation across four Age Categories

There was progressive increase in mean WAZ of the children on the intervention and it was statistically significant from entry through exit, graduation and current status (-1.34 ± 0.09 , $P=0.0009$, -1.12 ± 0.10 , $P=0.0011$, -1.07 ± 0.12 , $P=0.0009$ and -0.77 ± 0.09 , $P=0.0007$). WAZ increased by 0.22 at entry to exit. However, at exit to current status, WAZ increased by 0.35, nearly double the increment at entry and exit status. Also, there was a statistically significant progressive increase in mean WAZ at entry and exit stages across four age categories; aged 6-12 months (-1.45 ± 0.13 and -1.33 ± 0.13 , $P=0.034$), aged 12-24 months (-1.33 ± 0.17 and 0.96 ± 0.17 , $P=0.006$), aged 24-36 months (-1.26 ± 0.14 and -1.33 ± 0.14 , $P=0.01$) and 36-48 months (-1.38 ± 0.24 and -1.38 ± 0.35 , $P=0.495$). This implies that rehabilitation was experienced across the age categories during the Hearth sessions.

WAZ of the children on the intervention at graduation and current status increased progressively across the four age categories and was statistically significant ($P \leq 0.05$) as shown in Table. 1. At current status, children across the four age categories were normal for underweight since they attained mean WAZ greater than -1, the WHO recommendations for an ideal population group. WHZ at current status across the four age categories was also greater than -1, thus, the children on the intervention were normal for wasting as revealed in Table 1. However, children had mild stunting across the four age categories with HAZ values lower than -1. Children aged 6-12 months attained the

highest HAZ (-1.02 ± 0.30) and 24-36 months attained the least (-1.70 ± 0.25) which put them at risk of MAM.

Table 1: Indicators for Children on the intervention across four Age Categories

Variable	6-12 Months n=5	12-24 Months n=22	24-36 Months n=16	36-48 Months n=10
Entry to Hearth WAZ (Mean±SE)	-1.45±0.13 □	-1.33±0.17 □	-1.26±0.14 □	-1.38±0.24 □
Exit from Hearth WAZ (Mean±SE)	-1.33 ± 0.13 □	0.96 ± 0.17 □	-1.33 ± 0.14 □	-1.38 ± 0.35 □
Graduation WAZ (Mean±SE)	-0.93±0.15 □	0.81±0.17 □	-1.03±0.24 □	-1.07±0.23 □
Current Status Age (Mean±SE)	11.99±0.24	21.57±0.71 □	35.71±0.91	46.99±0.17 □
WHZ (Mean±SE)	-0.20±0.13 □	-0.15±0.24 □	0.05±0.31 □	-0.04±0.15 □
HAZ (Mean±SE)	-1.02±0.30 □	-1.36±0.25 □	-1.70±0.25	-1.14±0.13 □
WAZ (Mean±SE)	-0.71±0.17 □	-0.76±0.17 □	-0.87±0.20 □	-0.65±0.08 □

□ Significantly different at $P < 0.05$

4.3.2 Extent of Rehabilitation in five Communities

Table 2 shows nutrition indicators for children on the intervention across the five communities. With regards to WAZ, there was statistically significant progressive increase at entry and exit in Nyakune (-1.11 ± 0.09 and -0.99 ± 0.11 , $P=0.007$), Ntimaru (-1.26 ± 0.19 and -1.12 ± 0.19 , $P=0.008$) and Kegonga communities (-1.79 ± 0.26 and -1.20 ± 0.30 , $P=0.035$). There was also progressive increase in WAZ at entry and exit in Maroo and Thimlich communities ($P > 0.05$), but not significantly different. Similarly, WAZ progressively increased at exit and graduation in all the five communities, but the

progressive increase was significantly different for only Nyakune ($P=0.001$) and Ntimaru communities ($P=0.04$).

Table 2: Nutrition Indicators for Children on the intervention in five Communities

Variable	1-Maroo n=12	2-Nyakune n=12	3-Thimlich n=10	4-Ntimaru n=9	5-Kegonga n=10
Entry to Hearth					
Age (Mean±SE)	26.40±2.94 □	21.8±3.23 □	23.43±2.64	24.48±4.01 □	19.65±0.80 □
Weight	10.48±0.52 □	9.33±0.61 □	9.85±0.34 □	10.13±0.81 □	8.96±0.34 □
WAZ (Mean±SE)	-1.28±0.19 □	-1.11±0.09 □	-1.26±0.22 □	-1.26±0.19 □	-1.79±0.26
Exit from Hearth					
Weight	10.78±0.52	9.52±0.62	9.92±0.35	10.38±0.83	9.8±0.38 □
WAZ (Mean±SE)	-1.07±0.18 □	-0.99±0.11 □	-1.25±0.29 □	-1.12±0.19 □	-1.20±0.30 □
Graduation					
WAZ (Mean±SE)	-1.01±0.28	-0.97±0.11	-1.05±0.29	-0.92±0.19	-1.10±0.27
Current Status					
Age (Mean±SE)	32.06±2.98 □	26.90±3.24	29.18±2.64	28.24±4.08	24.41±0.81
Weight	11.24±0.56 □	10.39±0.59	11.04±0.46	11.37±0.81	9.7±0.35 □
WHZ (Mean±SE)	-0.04±0.16 □	0.31±0.30 □	0.54±0.22 □	-0.21±0.23 □	-1.05±0.42 □
HAZ (Mean±SE)	-1.58±0.38 □	-1.39±0.32 □	-1.82±0.29 □	-0.70±0.20 □	-1.35±0.09 □
WAZ (Mean±SE)	-0.91±0.17 □	-0.45±0.10 □	-0.53±0.16 □	-0.53±0.14 □	-1.42±0.29 □

□ Significantly different at P< 0.05

Progressive increase in WAZ was significantly different at graduation and current status in Maroo ($P=0.046$), Thimlich ($P=0.040$) and Ntimaru communities ($P=0.0016$). Progressive increase in WAZ was also noted in Nyakune, though not statistically different. However, Kegonga experienced a drop in WAZ, thus, a rehabilitation set back. In addition, Kegonga community had the least WHZ (-1.05 ± 0.42) and a significantly low HAZ. Nevertheless, HAZ was extremely lower in Thimlich (-1.82 ± 0.29), Maroo (-1.58 ± 0.38) and Nyakune (-1.39 ± 0.32), but not statistically significant ($P > 0.05$). Though there was an increase in WAZ at the completion of the hearth sessions in each of the five communities, an experience of rehabilitation, no community completely rehabilitated mild underweight children at exit since they all had WAZ lower than -1. At current status, all the communities had WAZ greater than -1, thus, complete rehabilitation of underweight was attained. Overall, there was WAZ increase at entry, exit and current status (-1.34 ± 0.09 , -1.12 ± 0.10 and -0.77 ± 0.09) for the intervention group. The rate of WAZ increase was higher between exit and current status, $r=1.74$, as shown in Figure 3.

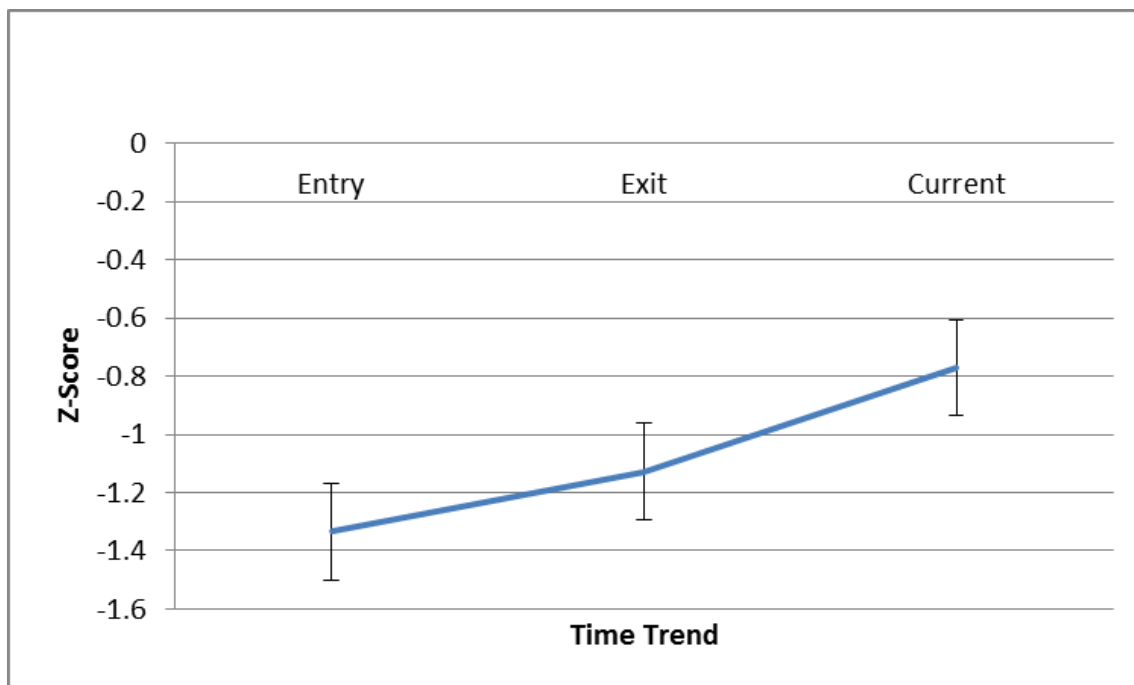


Fig 3: Gradient of WAZ at Entry, Exit and Current Status (bars represent SD)

PD Hearth program graduation rates were also compared across the five communities. Maroo and Nyakune communities had the desired graduation rate, with all the participating children attaining the WHO 100-400 g recommended weight gain. Ntimaru had the least graduation rate (75%), while Thimlich and Kegonga had equal graduation success 83.3%. There was a weak, positive, partial Pearson Correlation between weight at entry and graduation success, controlling for age ($r=0.022$, $n=53$, $P < 0.005$). High graduation success was associated with high weight gain as revealed in Maroo and Nyakune ($r=0.123$, $n=53$, $P < 0.005$). However, low graduation rate was not necessarily associated with low WAZ ($r=0.00$, $n=53$, $P < 0.001$) since Ntimaru had the least graduation rate, but sustained rehabilitation at exit, graduation and current status.

4.3.4 Comparison with WHO Reference Standards

When compared with the WHO standards, the children on the intervention at entry were extremely shifted to the left of the distribution curve compared to the reference population (Figure 4). This distribution graph revealed that more than half of the children had WAZ lower than -1.

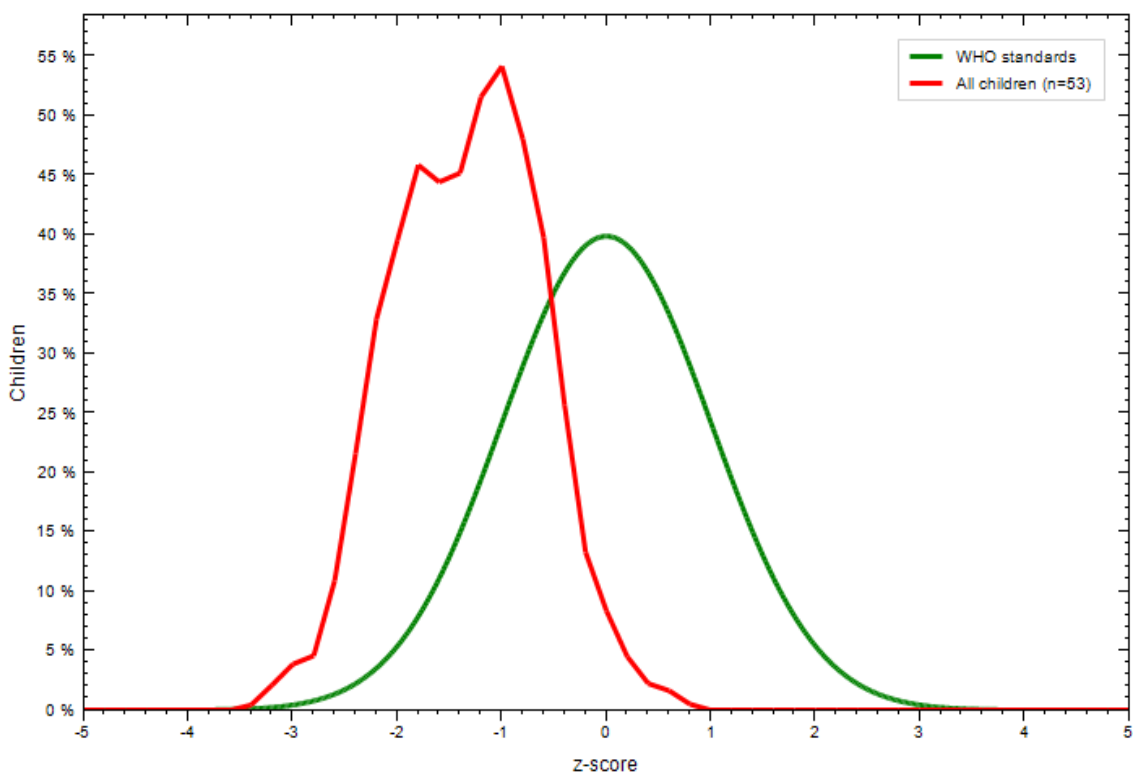


Fig 4: Distribution of WAZ for the Children on the intervention, Entry

At current status, as shown in Figure 5, there was a slight shift to the left of the distribution curve for WAZ of the children on the intervention compared to the reference population, with 60% of the children on the intervention attaining WAZ higher than -1.

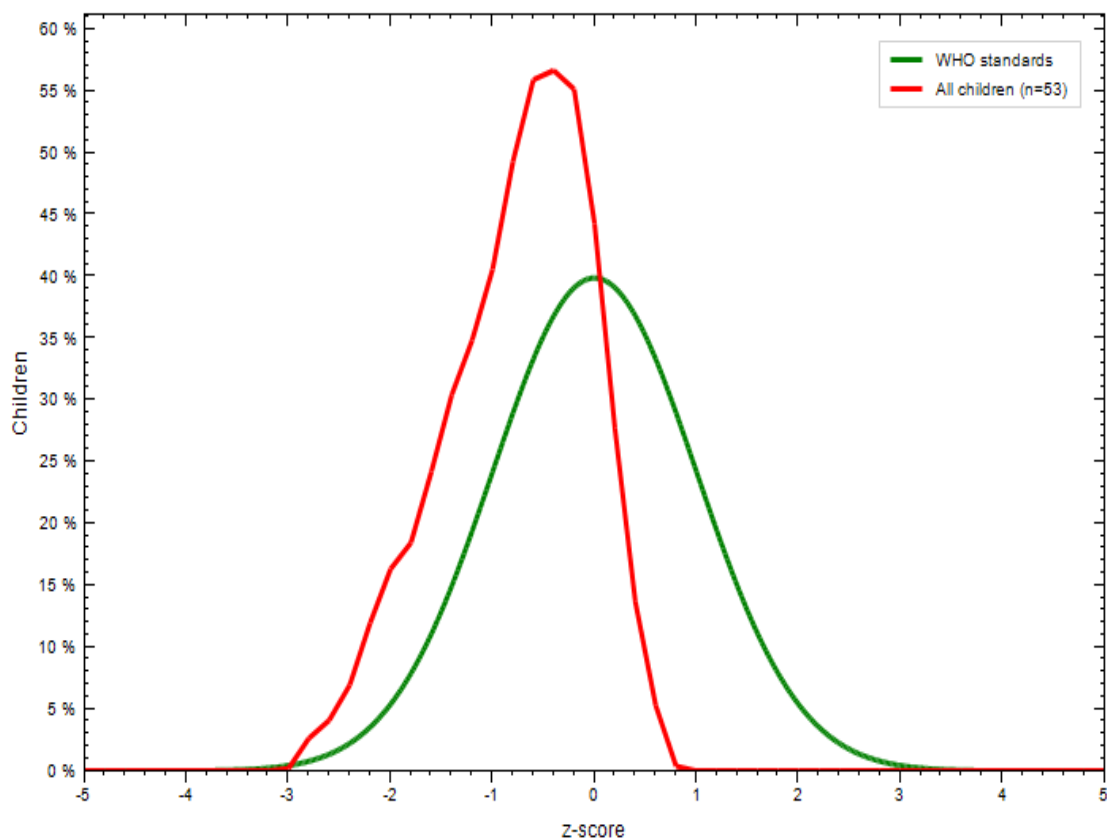


Fig 5: Distribution of WAZ for the Children on the intervention, Current Status

As shown in Figure 6, it is evident that there is still a high level of chronic malnutrition, with around 4% moderately wasted, 22% moderately and severely stunted and 4% moderately underweight.

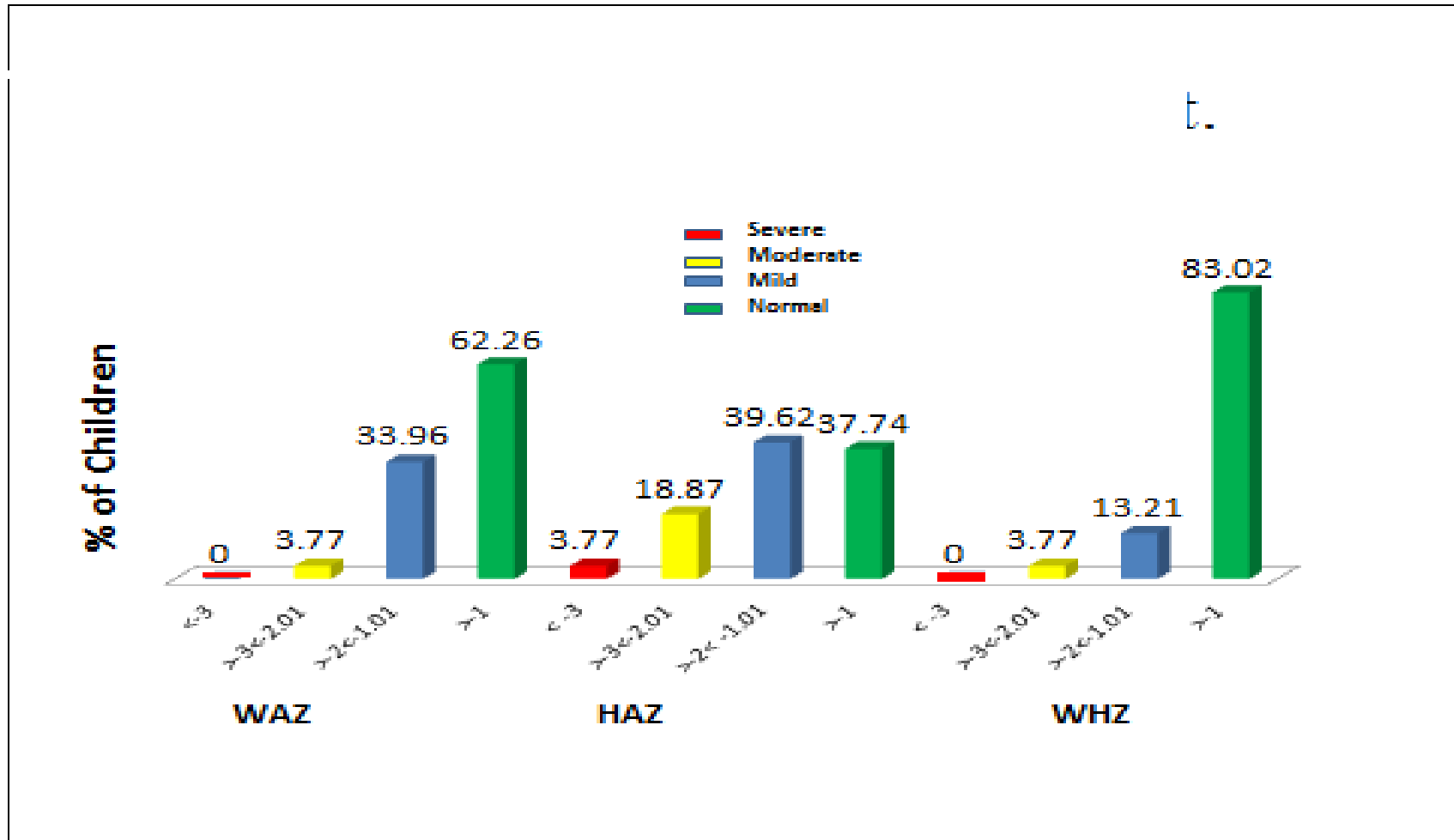


Fig 6: Nutrition outcome of Children on the intervention at Current Status

Therefore, PD Hearth intervention rehabilitated acute malnutrition but not chronic malnutrition in the intervention children.

4.4 PD Hearth Sustain Rehabilitation

4.4.1 Rehabilitation Sustenance across Age Categories

Majority (41.5%) of the children on the intervention had mean age of 21.6 ± 0.7 (12-24 age category), whereas, 44.4% of the comparison group had mean age of 29.6 ± 0.7 (24-36 age category) as shown in table 3. Difference in Mean WAZ at entry and current status for children in this age category was (0.57) for the intervention group and (0.24) for the comparison group (Table 3). Thus, at current status, children on the intervention had attained normal nutrition status for underweight, but comparison children still had mild underweight and were at risk of MAM. For the intervention group, there was significant difference in mean WAZ at entry and at current status ($P=0.023$). Also, the mean WAZ at current status was greater than -1, an indication of sustained efforts by the caregivers.

Similar results were noted in age categories 6-12, 24-36 and 36-48 for the children on the intervention. For the comparison group, apart from the 24-36 age category, there was reduction in WAZ at entry and current status, an indication of deterioration in their nutrition status.

Table 3: Indicators for Children on the intervention and Comparison Group by Age

Variable/Age	Intervention Group	Comparison Group
6-12 Months (%)	9.43	5.56
Age (Mean±SE)	11.99±0.24 □	10.56±0.68 □
WAZ at entry (Mean±SE)	-1.45±0.13 □	-1.24±0.38 □
WAZ at graduation (Mean±SE)	-0.93±0.15 □	-
WAZ at current (Mean±SE)	-0.71±0.17 □	-1.49±0.47 □
12-24 Months (%)	41.51	25.93
Age (Mean±SE)	21.57±0.71	18.61±0.85 □
WAZ at entry (Mean±SE)	-1.33±0.17 □	-0.87±0.20 □
WAZ at graduation (Mean±SE)	-0.81±0.17 □	-
WAZ at current status (Mean±SE)	-0.76±0.17 □	-0.99±0.29
24-36 Months (%)	30.19	44.44
Age (Mean±SE)	35.71±0.91 □	29.60±0.71 □
WAZ at entry (Mean±SE)	-1.26±0.14 □	-1.32±0.16 □
WAZ at graduation (Mean±SE)	-1.03±0.24 □	-
WAZ at current status (Mean±SE)	-0.87±0.20 □	-1.08±0.14 □
36-48 Months (%)	18.87	24.07
Age (Mean±SE)	46.99±0.17 □	37.86±0.88 □
WAZ at entry (Mean±SE)	-1.38±0.24 □	-1.12±0.18 □
WAZ at graduation (Mean±SE)	-1.07±0.23 □	-
WAZ at current status (Mean±SE)	-0.65±0.08 □	-1.30±0.21 □

□ Significantly different at $P < 0.05$

Hypothesis Testing

H₀: PD Hearth intervention do not improve nutritional outcomes beyond graduation

A paired-sample *t*-test was conducted to evaluate the impact of the PD Hearth intervention on nutrition outcomes beyond graduation. There was a statistically significant increase in weight-for-age Z-score from WAZ at graduation ($M = -1.13$, $SD = 0.71$) to WAZ at current status ($M = -0.77$, $SD = 0.68$), $t(52) = -3.355$, $P < 0.01$ (two tailed). The mean increase in WAZ was 0.36 with a 95% confidence interval ranging

from -0.57 to -0.14. Thus, the researcher rejected the hypothesis PD Hearth intervention do not improve nutritional outcomes beyond graduation. In addition, the magnitude of the difference in the means (mean difference = -0.36, 95% CI: -0.57 to -0.14) was very large (eta squared=0.17) indicating a big effect size.

$$\text{Eta squared} = \frac{t^2}{t^2 + N - 1}$$

The guidelines proposed by Cohen (1988) for interpreting eta value are 0.01=small effect, 0.06=moderate effect and 0.14=large effect.

Overall, of the children in the intervention, at entry, 18.9% were moderately underweight while 43.4% had mild underweight. At current status though, 3.8% were moderately underweight and 34.0% had mild underweight. For the comparison children, 13.2% and 49.1% had moderate and mild underweight at baseline. However, at current status, 3.7%, 7.4% and 44.4% had severe, moderate and mild underweight respectively. This implies that PD Hearth nutrition program rehabilitated both mild and acute malnutrition children in the intervention while the nutrition status of the comparison group worsened.

4.4.2 Rehabilitation Sustenance by Gender and WHO Reference Standards

Female children recorded gains in WAZ for both the intervention and comparison groups, but the male children in the intervention programme had the highest improvement in WAZ beyond graduation (Table 4).

Table 4: Indicators for Children in the intervention and Comparison Group by Gender

Variable/Gender	Intervention Group	Comparison Group
Female		
Age (Mean±SE)	27.8±1.8	26.7±1.6
WAZ at entry (Mean±SE)	-1.11±0.11 □	-1.16±0.13 □
WAZ at graduation (Mean±SE)	-0.77±0.18 □	
WAZ at current status (Mean±SE)	-0.47±0.08 □	-0.93±0.16 □
Male		
Age (Mean±SE)	29.2±2.8	28.9±1.7
WAZ at entry (Mean±SE)	-1.65±0.12 □	-1.14±0.17 □
WAZ at graduation (Mean±SE)	-1.17±0.16 □	-
WAZ at current status (Mean±SE)	-0.58±0.24 □	-1.40±0.14 □

□ Significantly different at $P < 0.05$

Figure 7 and Figure 8 show the shift, by gender, in WAZ of the children on the intervention from the WHO reference standards. At graduation, more than 60% of both males and females were extremely shifted to the left of the distribution curve for WAZ compared to the reference population. But more males (68%) were shifted too close to -2 scores than females (62%) who were concentrated close to -1 scores.

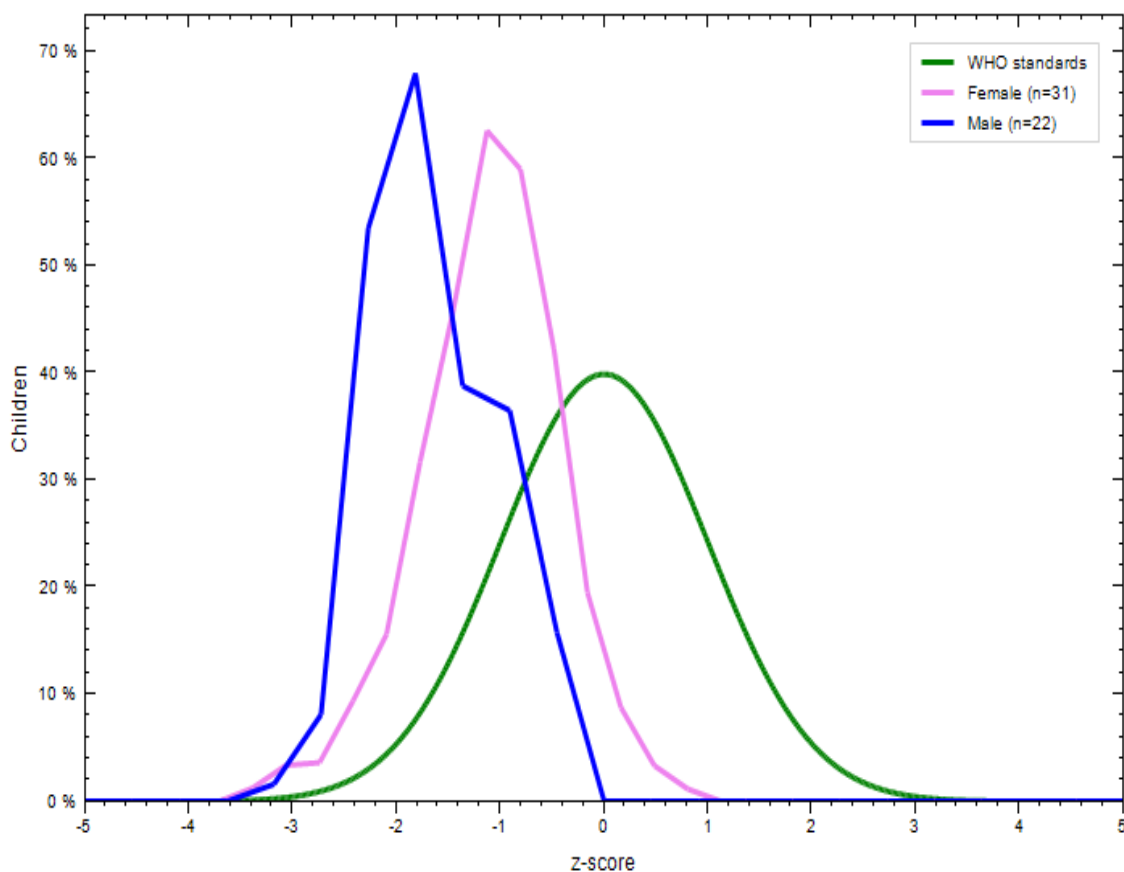


Fig. 7: Distribution of WAZ for children on the intervention by gender, graduation

At current status, few male children (44%) were slightly shifted to the left of the distribution curve for WAZ compared to the reference population (too close to -1 score). On the other hand, 88% of the females perfectly matched the distribution curve for WAZ compared to the reference population (too close to 0 score).

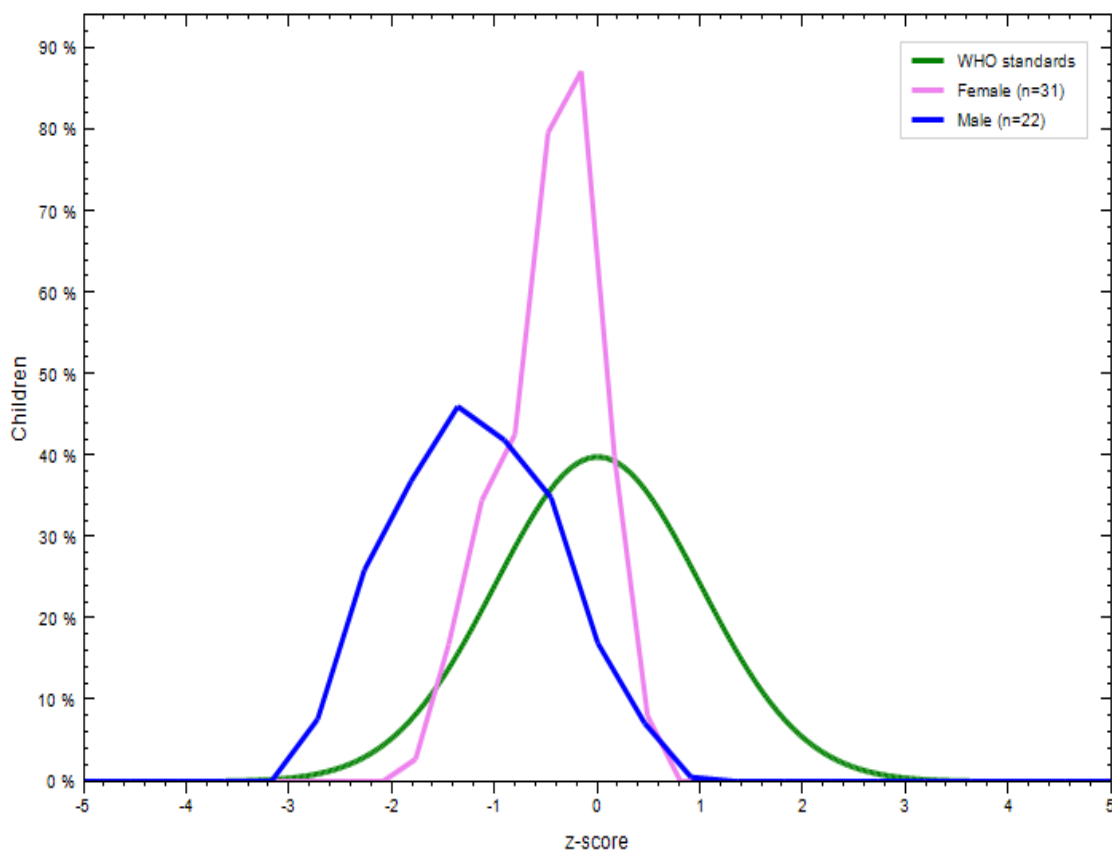


Fig. 8: Distribution of WAZ for children on the intervention by gender, current status

Therefore, the intervention families sustained the nutrition outcome beyond graduation for both male and female children.

Hypothesis Testing

H₀: PD Hearth do not prevent malnutrition in both younger female and male siblings

An independent *t*-test was conducted to evaluate the impact of the PD Hearth intervention in preventing malnutrition in both the younger female and male siblings. There was

statistical significance in WAZ, WHZ but not HAZ of the younger siblings $P > 0.05$ (Table 5). Thus, the researcher failed to reject the hypothesis PD Hearth do not prevent malnutrition in both the younger female and male sibling.

Table 5: Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
WHZ Equal variances assumed	7.84	.008	1.22	34	.23	.70	.58	-1.03	1.88
Equal variances not assumed			.91	9.60	.39	.70	.77	-1.03	2.44
HAZ Equal variances assumed	.64	.43	-.56	34	.58	-.22	.39	-1.01	.57
Equal variances not assumed			-.45	10.68	.65	-.22	.47	-1.25	.81
WAZ Equal variances assumed	17.17	.00	.87	34	.39	.40	.46	-1.01	1.34
Equal variances not assumed			.64	9.49	.54	.40	.63	-1.01	1.81

Significantly different at $P < 0.05$

4.4.3 Rehabilitation Sustenance in Communities

Table 6 shows nutrition status at current status, children on the intervention had normal nutrition score for underweight (score higher than -1) in all the communities, except Kegonga with mild underweight children. Also, the children on the intervention had better mean WAZ at current status than at entry to Hearth, an indication of sustained progress. The greatest improvement in mean WAZ was noted in Ntimaru (0.73) and Thimlich communities (0.73). This is an indication that the latter communities sustained rehabilitation better.

Table 6: Indicators for Children on the intervention and Comparison Group by Community

Variable/Community	Intervention Group	Comparison Group
Maroo		
Age (Mean±SE)	32.06±2.98	28.06±3.14
WAZ-Entry to Hearth (Mean±SE)	-1.28±0.19 □	-0.91±0.22 □
WAZ-Current Status (Mean±SE)	-0.91±0.17 □	-1.26±0.20 □
Nyakune		
Age (Mean±SE)	26.90±3.24	27.14±2.63
WAZ-Entry to Hearth (Mean±SE)	-1.11±0.09 □	-0.57±0.22 □
WAZ-Current Status (Mean±SE)	-0.45±0.10 □	-0.93±0.26 □
Thimlich		
Age (Mean±SE)	29.18±2.64	23.80±2.77
WAZ-Entry to Hearth (Mean±SE)	-1.26±0.22 □	-1.80±0.14 □
WAZ-Current Status (Mean±SE)	-0.53±0.16 □	-1.13±0.33 □
Ntimaru		
Age (Mean±SE)	28.24±4.08	29.43±2.26
WAZ-Entry to Hearth (Mean±SE)	-1.26±0.19 □	-1.14±0.26 □
WAZ-Current Status (Mean±SE)	-0.53±0.14 □	-1.39±0.30 □
Kegonga		
Age (Mean±SE)	24.41±0.81	29.56±2.47
WAZ-Entry to Hearth (Mean±SE)	-1.79±0.26 □	-1.12±0.15 □
WAZ-Current Status (Mean±SE)	-1.42±0.29 □	-0.96±0.17 □

□ Significantly different at P < 0.05

4.5 Nutritional Status among the Younger Siblings

Nutrition indicators, WAZ, HAZ and WHZ for younger siblings were computed across the age categories, by gender and community.

4.5.1 Nutritional Status of Younger Siblings across Age Categories

Table 7 shows the 3 nutrition indicators across four age categories. It was established that there was significant difference in mean age across the four age categories. Children aged 0-6 months and 6-12 months had high nutrition indicators (above -1 score) for mean WAZ, HAZ and WHZ. In this regard, these children were normal and not at risk of the three forms of malnutrition, underweight, stunting and wasting. Also, children in the age categories, 12-24 and 36-48 had high Z-scores (greater than -1 score) in WHZ and WAZ, thus, normal for acute malnutrition. However, they had -2.14 ± 0.04 and -1.23 ± 0.42 scores for HAZ, hence, they suffered from moderate and mild chronic malnutrition. Older children (46-60 months) were normal for wasting but had mild underweight and stunting. Therefore, the scores for nutrition indicators were better for younger siblings than their older counterparts.

Table 7: Nutrition Indicators for Siblings across four Age Categories

Variable	0-6 Months n=5	6-12 Months n=16	12-24 Months n=4	36-48 Months n=9	48-60 Months n=2
Age (M±SE)	3.792±0.93 □	8.09±0.47	12.67±0.29	40.66±0.71	56.21±0
Weight	7.24±0.79 □	□	8.5±0.29 □	□	□
Height	60.84±2.80	8.85±0.34	69.25±0.43	13.86±0.42	14.9±0
WHZ (M±SE)	1.86±0.44	□	0.64±0.25	□	□
HAZ (M±SE)	-0.074±0.49	67.15±0.61	□	93.67±1.86	101±0 □
WAZ (M±SE)	□	1.54±0.45	-2.14±0.04	0.15±0.33	-0.45±0
	1.32±0.15 □	□	□	□	□
		-0.89±0.17	-0.56±0.22	-1.23±0.42	-1.38±0
		□	□	□	□
		0.67±0.31		-0.59±0.24	-1.16±0
		□		□	□

□ Significantly different at P< 0.05

4.5.2 Younger Siblings by Gender

With reference to gender, female siblings had normal nutrition status for all the three forms of malnutrition as shown in Table 8. Equally, their male counterparts, had strong scores for WAZ and WHZ, but not HAZ (-1.12±0.43), thus, they had mild stunting.

Table 8: Nutrition Indicators for Siblings by gender

Variable/Gender	Z-Scores
Female (n=27)	
Age (Mean±SE)	19.11±3.40
WHZ (Mean±SE)	0.85±0.23 □
HAZ (Mean±SE)	-0.97±0.17 □
WAZ (Mean±SE)	0.11±0.18 □
Male (n=9)	
Age (Mean±SE)	17.93±5.52 □
WHZ (Mean±SE)	1.55±0.74 □
HAZ (Mean±SE)	-1.12±0.43 □
WAZ (Mean±SE)	0.51±0.60 □

□ Significantly different at P< 0.05

4.5.3 Communities

Siblings in all the five communities had Z-scores greater than -0.35 for 2 of the 3 nutrition indicators, WAZ and WHZ, thus, normal for acute malnutrition as shown in Figure 9. However, for chronic malnutrition, siblings were poorly ranked with Ntimaru community recording the least mean HAZ.

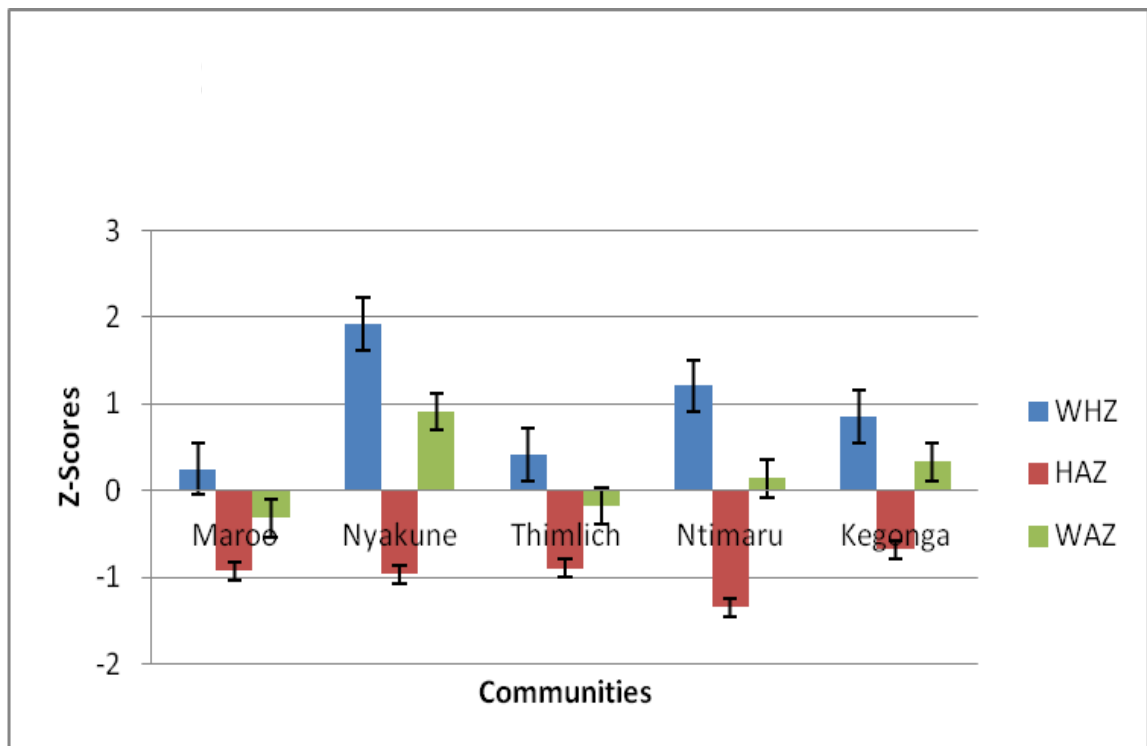


Fig. 9: WHZ, HAZ and WAZ Indicators in Siblings

Therefore, PD Hearth intervention prevented acute malnutrition in all the communities.

4.6 Practices which Influence PD Health Outcome

Practices which influence PD Health outcomes were assessed in 3 different ways; behavior changes, improved local capacity and community participation and empowerment.

4.6.1 Behaviour change

On average, meal frequency was significantly higher among the caregivers of children aged < 24 months and > 24 months at PDI than at current status (5.9 ± 3.5 and 4.4 ± 2.2 ; 5.3 ± 3.3 and 5.2 ± 2.2 , $P < 0.001$) respectively. Although almost equal proportions of children at PDI and current status consumed food from 4 food groups, only 66% of the children at PDI fed on Vitamin A rich foods. On the contrary, 81.1% of children at current status were fed on Vitamin A rich foods, and as many as 96.2%, 84.6% and 90.2% had increased feeding frequency, increased food variety and increased feeding frequency after sickness. Thus, caregivers at current status fed more diverse foods and balanced diet on the average than at PDI.

The caregivers' breastfeeding behaviors differed significantly at PDI and at current status ($P < 0.023$). At PDI, only 13% of children were breastfed within an hour of birth. However, after intervention, 60.4% of the caregivers reported having fed their infants within an hour. Besides, 71.2% of mothers with infants 0-6 months reported having exclusively breastfed at current status, whereas, only 22% breastfed to completion at PDI.

Significant differences ($P=0.05$) were observed between caregiver hygiene practices at PDI and at current status, with caregivers at current status exhibiting better hygiene practices during feeding. They were more likely to wash their hands after leaving latrine and before feeding (90.6% vs. 16.0%, $\chi^2 = 6.13$, $P=0.01$) and more likely to feed on healthy snack (80.8% vs. 41.4%, $\chi^2=35.38$, $P < 0.01$). They were also more likely to involve their family members in ensuring better child care (85.7% vs. 76.3%, $\chi^2=4.80$, $P=0.03$), attending postnatal clinics once in a month (64.7% vs. 31.1%, $\chi^2=4.08$, $P < 0.01$) and taking a child to health provider (93.8% vs. 43.2%, $\chi^2=14.36$, $P=0.04$). Although after graduation there were better hygiene practices, the number of children who had diarrhea within two weeks to current status increased from 5% to 37.7% due to rotavirus outbreak at PDI and current status respectively. However, unlike at PDI, most caregivers (42.3% vs. 2%, $\chi^2=9.7$, $P=0.02$) took their children with diarrhea to hospital, with a few giving increased fluids and homemade ORS.

Linear standardized multiple regression was used to assess the caregiver practices (feed Vitamin A rich food, frequency of attending post-natal clinic, increased feeding frequency, frequency of washing hands, feed child on healthy snack, ensure family members participation in child care and take child to a health provider) to predict increase in weight (weight at current status), after controlling for the influence of marital status and level of education. Preliminary analyses were conducted to ensure that the assumptions of normality, linearity, multicollinearity and homoscedasticity were not violated. Level of education and marital status were entered at Step 1, explaining 11.2% of the variance in weight at current status. After entry of the 7 variables at step 2 the total

variance explained by the model as a whole was 64.5%, adjusted $R^2=0.426$, F change (9, 53) =6.07, $P < 0.01$. The 7 control measures explained an additional 43.3% of the variance in weight, after controlling for marital status and level of education, R^2 change=0.433, F change (7, 53) =4.04, $P=0.002$. In the final model, increased feeding frequency made the largest unique contribution ($\beta=-.73$), although family member participation, frequency of hand washing and frequency of attending post-natal clinic also made a statistically significant contribution as shown in Table 8. The model equation was used to determine the best fit weight at current status which was found to be 12.72 kg.

Model equation

$$y = a + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + \beta X_6 + \beta X_7 + e$$

X_i represents caregiver practices (in subsequent order as given in table 9) that predict increased weight at current status.

$$y = 16.04 + (-1.13)X_1 + (0.87)X_2 + (-6.62)X_3 + (1.40)X_4 + (-0.37)X_5 + (2.63)X_6 + (0.009)X_7 + 1.63$$

$$y = 16.04 + (1.34) + (-0.89) + (-6.87) + 1.58 + (-0.44) + 3.00 + 0.01 + 1.63 = \mathbf{12.72 \text{ Kg}}$$

Therefore, the regression model predicted 12.72 kg weight at current status for the children on the intervention with the mean age 28.5 ± 1.0 months based on the best fit line. The WAZ of these children lied on 51.5 percentile or 0.04 Z-score, thus, normal for underweight.

Table 9: Linear multiple standardized regression modeling for caregiver practices

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	16.04	1.63		9.84	.000
Feed Vit A rich Foods	-1.13	.95	-.24	-1.19	.240
Frequency of Attending Post Natal Clinic	-.87	.37	-.43	-2.34	.025
Increased Feeding Frequency	-6.62	2.30	-.73	-2.87	.007
Frequency of Washing Hands	1.40	.62	.35	2.25	.031
Healthy Snack	-.37	1.03	-.08	-.36	.723
Family Members Participation	2.63	1.05	.51	2.51	.017
Take Child to Health Provider	.009	1.58	.001	.006	.995

Dependent variable: Current Weight (Significantly different at $P < 0.05$)

4.6.2 Improved Local Capacity

Pertaining to improved local capacity, all caregivers at current status believed that the CHWs had the ability to implement PD Hearth programs with equal graduation rate, an improvement from PDI (11.3%). All caregivers also believed that the CHWs were able to supervise the implementation of these programs. At PDI, significantly large number of caregivers believed that the CHWs were able to motivate them to participate in PD Hearth programs, however, at current status this figure increased significantly. In addition, all the caregivers, at current status, believed that the CHWs are able to advocate for community resources better, identify Maternal Infant and Young Child Nutrition

Practices (MIYCN) practices/best practices to conduct PDI and also identify malnourished children. Thus, the PD Hearth program did not only influence behavior change in the caregivers, but also among the implementing CHWs.

Community Health Workers interviewed also confirmed these findings. They pointed out that while implementing PD Hearth programs most of their skills were enhanced. CHWs expressed their increased understanding of child health issues, food preparation and understanding of good nutrition practices. Others stated that they were better able to counsel mothers after implementing PD Hearth programs. Accordingly, CHWs interviewed believed that it is possible for poor families to have well-nourished children. Some felt that family economy plays a significant role in rehabilitation of malnourished children. Though all caregivers believed that CHWs could implement PD Hearth program on their own, most CHWs said they couldn't handle problems that might arise, and neither did they have the confidence in themselves. A number of the CHWs (75%) noted that there was a stronger link between them and the community leaders than before and that they were willing to advocate for material support for future activities. Conceivably, the most notable local capacity building occurred among the Nyakune CHWs. Most of them stated that the key to improving nutritional status is changing the mothers' behaviors, and not just providing food as was with the previous nutrition programs. Additionally, the nutritionist in Nyatike District indicated that by working directly with the community, they learnt more about nutritional value of food through menu planning, and more about existing community practices. The Maroo and Nyakune CHWs also stated that they learned more concept of PD Hearth and were motivated to implement

more nutrition programs. This is a clear indication that PD Hearth intervention improves capacity of the CHWs.

4.6.3 Community Participation and Empowerment

The caregivers felt that community participation was one of the PD Hearth program successes. In all the five communities visited the community leaders were aware of the PD Hearth, and were able to explain what happens at PD Hearth. Community leaders interviewed in Nyakune and Maroo locations said they received PD Hearth reports from the CHWs on the numbers of malnourished children and progress of the PD Hearth program. Indeed, the caregivers also attested to the leaders empowered ability since they would tell the consequences of malnutrition, including lowered education performance, retarded growth and increased morbidity and mortality. When the community leaders articulated and understood the consequences of malnutrition there was a substantial support from the individuals in the community and the individual leaders. For instance, in Ntimaru location, the village chief donated 12 kg of maize to each PD Hearth session, whereas 4 community members donated groceries. Local government did not support the PD Hearth programs financially but community leaders and health officers oriented the families. Some leaders paid regular visits to the hearths and their commitments were more pronounced during PD Hearth graduation. In fact, leaders in Nyakune, Maroo and Ntimaru communities mentioned that they were happy to be engaged in the health community programs, a verbal commitment that community leaders, through the PD Hearth program have taken a sense of responsibility to improve the status of malnourished children in their community.

CHAPTER FIVE

DISCUSSION

5.1 Overview

This chapter gives detailed discussion of the results with regards to the findings.

5.2 PD Rehabilitation of Malnourished Children

The present study demonstrated that PD Hearth rehabilitates acute malnutrition during Hearth sessions, follow ups and beyond graduation in children across four age categories (6-12, 12-24, 24-36 and 36-48) and in different communities. These results concur with an earlier review in Vietnam (Peacock *et al.*, 2013). Evaluation of 'pos gizi', Hearth sites, in Indonesia by McNulty and Pambudi (2008) also established that when PD Hearth is well implemented it rehabilitates malnourished children across the program phases; Hearth sessions, follow ups and beyond graduation. The WAZ increase between exit and current status was nearly double that of entry and exit status which is similar to a study by Mackintosh *et al.* (2002). The later study found that the rate of rehabilitation after exiting Hearth sessions is faster (2.6 times faster) than during the sessions.

Rehabilitation of underweight children was attained in most of the communities. In Kegonga this was not possible because a number of factors determined the outcome of PD Hearth program. These factors were not favorable in Kegonga and they included the willingness of the caregivers to participate in Hearth sessions, the receptiveness of the intervention families, the ability of the implementing CHWs and the level of facilitation by the funding NGO, World Vision Kegonga Area Development Program. The

rehabilitated underweight children attained normal score for wasting, but not stunting. This is a further indication that PD Hearth program rehabilitated acute malnutrition in children in the intervention but not chronic malnutrition. Bolles *et al.* (2002) and Parvanta *et al.* (2007) concur with the findings when they established that PD Hearth is the solution to acute malnutrition in both urban and rural settings. Le Roux *et al.* (2010) also reviewed performance of PD Hearth in South Africa; they established that PD Hearth within 1 year of graduation improves mean WAZ and WHZ in participating children, but not HAZ an indicator of stunting which can take very long to reverse.

A similar study by Pirooska and Bullen (2011) found that stunting increased from 19% to 26% in children in the intervention. This is consistent with the findings of this study which revealed that at current status more than a quarter of the children in the intervention had moderate stunting.

As pertains to graduation rate, it was found that high graduation rate is associated with high weight gain. Also, McNulty and Pambudi (2008) revealed that PD Hearth sites with high graduation rates are more likely to have receptive caregivers, highly skilled CHWs and motivated community leaders. These are indicators of successful PD Hearth implementation, hence, as a consequence of PD Hearth success, Maroo and Nyakune locations had the highest weight increment.

However, rehabilitation of the underweight children was not necessarily associated with graduation success. This is because Ntimaru location had the least graduation rate but sustained rehabilitation at exit, graduation and current status.

5.3 PD Hearth Sustains Rehabilitation

Although children in the intervention programme were more underweight initially, the study revealed that they were rehabilitated and had better nutrition status than the comparison children. This is an important finding, as poor nutrition is one of the major determinants of long term health status and is consistently linked to poor cognitive and development outcomes over the lifespan (Le Roux *et al.*, 2010).

McNulty (2005) agree that PD Hearth program is initiated to rehabilitate moderate and mild malnutrition among children thus registers better nutrition outcomes than in comparison group. Also, earlier program evaluations in India by Sethi *et al.* (2007) found that PD Hearth interventions sustain rehabilitation in infants (42.9 %) better than the comparison group (53.7%).

However, not all PD Hearth evaluations found better sustained efforts for the children in the intervention than the comparison counterparts. Pirooska and Bullen (2011) established that there was no significant difference between intervention and comparison group. In the same way, Nti and Lartey (2007) found that 22% of the children in the intervention had moderate malnutrition and 9.8% severe malnutrition. They also reported that wasting was higher in the children on the intervention. The evaluation studies where comparison

children registered better rehabilitation sustenance indicated that children on the intervention were older than their counterparts (Nti & Lartey, 2007).

When PD Hearth intervention is implemented by strictly following the CORE GROUP guidance principles, then most of the confounders are likely to be controlled (McNulty, 2005). In this regard, a properly structured and well implemented PD Hearth intervention will always sustain rehabilitated children. However, within a year of program implementation, not all cases of MAM will be rehabilitated.

With regards to gender, female children sustained rehabilitation better than their male counterparts in both the intervention and comparison group. However, rehabilitation sustenance in intervention group was more distinct. This finding is consistent with Le Roux *et al.* (2010) proposition that regardless of the gender PD Hearth model successfully improves children nutrition status. Furthermore, the findings by Bolles *et al.* (2002) on the sustenance of the PD outcomes after the program implementation were positive for the both genders in two studies, with the study conducted after 6 months revealing marginal sustenance of the PD outcomes than the study conducted after one month.

Similarly, intervention rehabilitation across the communities was better than that of the comparison groups with the exception of Kegonga. A closer analysis established that better underweight rehabilitation sustenance was achieved in Ntimaru and Thimlich communities. This is attributed to by a number of reasons including influence by the

Hearth site, the receptiveness of the participating families, the role of community leaders in the specific sites, the implementing CHWs and the facilitation by the funding NGO (McNulty, 2005).

5.4 PD Hearth Prevents Malnutrition in Younger Siblings

Younger siblings of the children in the intervention in all the communities had normal nutrition status for underweight and wasting, but not stunting. This is in tandem with the children in the intervention who had normal nutrition status for underweight and wasting, but not stunting, an indication that PD Hearth program better rehabilitates acute malnutrition than chronic malnutrition. As reported by Parvanta *et al.* (2007), caregivers for the children in the intervention use the care practices, knowledge and skills they learn in the intervention to make better lives of all children. This ‘spillover effect’ is more pronounced in younger siblings because they have the ability to attain ‘catch up growth’ like their older children on the intervention.

Girls had better rehabilitation than boys for both intervention and comparison children. Also, female younger siblings had normal nutrition status for all the three forms of malnutrition; wasting, stunting and underweight. This could be an indication that female children respond faster to PD Hearth intervention than the male children. But as revealed in hypothesis testing, the response effect is not due to intervention.

5.5 Practices which Influence PD Hearth Outcome

5.5.1 Behaviour Change

Behavior change was identified using indicators agreed on by the World Vision International (McNulty and Pambudi, 2008). It was noted that the number of food groups consumed per day by children in the two age categories 6-24 and 24-59 went down. Data from the NGO's food security indicators established that food security had become worse over the life of the PD Hearth project. For instance, households' classified as food insecure with severe hunger increased from 23% in the baseline survey to 37% in the final survey (World Vision Report, 2014). In spite of this, there was a significant reduction in underweight in the five communities. Perhaps, this could be due to better caregiver practices learned during the Hearth sessions. Parvanta *et al.* (2007) used randomized control trial to identify practices which improve PD Hearth outcomes. He revealed that better intervention outcomes ($P=0.003$) were identified in mothers who reported feeding children vegetables in the past 48 hours as well as mothers who reported feeding children recommended portion of green vegetables in the intervention ($P=0.001$). Similarly, Marsh *et al.* (2009) established that children in the intervention had better nutrition because they consumed more food per day and were more likely to meet their daily nutrient requirement than comparison group. These practices matched the caregiver practices in 4 of the five communities after the completion of Hearth sessions. Indeed, there was increased child feeding frequency which was the single highest contributor to weight gain.

UNICEF (2009) noted that good caregiver practices are suitable for rehabilitating malnourished children. UNICEF further revealed that inadequate dietary intake and diseases are the two immediate causes of malnutrition (UNICEF, 2009). Thus, improving care practices which increase dietary intake comes handy in rehabilitating malnutrition (APHRC, 2010). Also, Le Roux *et al.* (2010) established that recovery from malnutrition occurs with improvement in children's diets. These include conforming closely to the recommended infant and young child nutrition practices, exclusive breastfeeding and intake of the appropriate food proportions. The PD Hearth intervention also encouraged caregivers to improve on maternal child care practices including exclusive breastfeeding, better hygiene practices such as hand washing, taking child to hospital when sick and treating diarrhea through ORS and increased fluids. PD Hearth intervention enhanced the community adoption of these practices by breaking the chief traditional barriers; limited information and insufficient resources (Bradely *et al.*, 2009). This is because PD Hearth intervention addressed the critical components of the recovery pathways such as the costs, availability of the resources and improving the mothers caring practices which are associated with high malnutrition incidences (UNICEF, 2009).

The health and care behaviors practiced by the PD mothers beyond graduation which predicted weight gain can be classified into three categories; provision of adequate diet, adequate health care and good hygiene practices. These are consistent with the UNICEF (2009) classification of the practices needed to address the underlying causes of malnutrition. Perhaps, these explain why the younger siblings of the children on the

intervention had good nutrition status for both underweight and wasting, with all the five communities recording Z-scores greater than 0 for the latter.

5.5.2 Improved Local Capacity

The outstanding feature of PD Hearth intervention is its multifold purposes: rehabilitation of underweight in children; sustenance of rehabilitation; prevention of acute malnutrition in younger siblings and promotion of behavior change in caregivers and CHWs. With regards to the later, it increases CHWs understanding of child health issues, food preparation and good nutrition practices. It also gives CHWs the feeling that they are better able to counsel mothers after implementing PD Hearth programs. PD Hearth further creates a stronger link between the CHWs and the community leaders, thus, enhancing their will to advocate for material support for future activities. Therefore, PD Hearth intervention is extremely significant since CHWs plays a big role in community related issues (Schwartz, 2012). Community Health Workers are the ‘eyes’ and the ‘ears’ of the health facilities in every community when it comes to implementing health interventions (Schwartz, 2012). The CHWs role in lowering the medical cost which is the major health problem for many nations is also magnificent (Sidze and Brinton, 2012).

5.5.3 Community Participation and Empowerment

It was established that community leaders in the five communities were materially committed to the implementation of PD Hearth intervention. As revealed in the study, communities with committed leaders had the best rehabilitation and rehabilitation sustenance. These communities also prevented malnutrition in the interventions’ younger

siblings. Community leaders influence a number of activities in the community, including the receptiveness of the community to interventions (Love, Gardener and Legion, 2007). In addition, UNICEF (2009) ascertained that community leader's participation in community interventions is key to the success or failure of interventions intended to alleviate malnutrition. Thus, at the basic cause of malnutrition, UNICEF (2009) pointed out political and ideological superstructures which community leaders are part.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

From the results of this study the following conclusions can be made:

1. PD Hearth intervention rehabilitates acute but not chronic malnutrition.
2. PD Hearth intervention sustains rehabilitation of acute malnutrition.
3. PD Hearth intervention had a spillover effect in younger siblings of children in the intervention.
4. Increase in feeding frequency makes the single most contribution to weight gain in PD Hearth intervention.

6.2 Recommendations

Based on the results of this study the following recommendations are made

1. Height measurements need to be taken at PD entry to provide height-for-age indicator and tailor the Hearth sessions to manage both acute and chronic malnutrition.
2. The MoH in collaboration with the Migori County government need to scale up PD Hearth interventions to reverse MAM and prevent SAM.
3. The policy makers need to integrate the Hearth community model structure in nutrition education programs to prevent malnutrition in siblings of malnourished children.

4. Ministry of Health and NGOs need to foster interventions that promote increase in feeding frequency and encourage nutrition education among mothers.
5. Ministry of Health need to ensure adequate training of personnel to provide nutrition education to mothers.
6. Community Health Workers need to carry out continuous follow up of the children in the intervention and their caregivers to ensure that mothers practice what they are taught in the Hearth sessions.

RECOMMENDATION FOR FURTHER STUDIES

There is need for a similar study using large samples and where the researcher participates in the initiation and implementation of the PD Hearth intervention.

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APPENDICES

Appendix 1: Questionnaire

(Tick where necessary)

BACKGROUND INFORMATION

Gender	Male		Female	
Marital Status	Single	Separated	Married	Divorced
Age Structure	Below 18	18-30	30-40	Above 40
Level of education	Secondary	College	University	Other (Specify)
Work Experience	Below 1 year		Between 1-3 years	Above 3 years
Employment Status	Temporary		Contractual	Permanent

IMPROVED NUTRITION STATUS

a. PD Program Rehabilitate Malnourished Children

1. Weight measurement at the time of PD Program entry
2. Weight measurement at the time of PD Program exit.....
3. Weight measurement at the time of PD Program graduation.....
4. Age at the time of PD Program entry.....

b. PD Program Sustain Rehabilitation Outcome

5. Current weight measurement.....
6. Current height measurement.....
7. Current age of the child.....

c. PD Prevent Malnutrition in Younger Children

8. Current weight measurement.....
9. Current height measurement.....
10. Current age of the child.....

HEALTH AND CARE BEHAVIORS

11. What was the age of your child at the time of intervention?

.....

12. What was the age of younger siblings (below 59 months) at the time of intervention?

.....

13. Did you breastfeed your intervention child within an hour after birth?

a. Yes { } b. No { }

14. Did you breastfeed child (children) you conceived after intervention within an hour after birth?

a. Yes { } b. No { }

15. Did you exclusively breastfeed your intervention child for the first 6 months?

a. Yes { } b. No { }

16. Did you exclusively breastfeed child/children you conceived after intervention for the first 6 months?

a. Yes { } b. No { }

17. In the past 24 hours did you feed your child/children aged 6-24 months foods from any of these food groups?

Bread, Cereal and Potatoes a. Yes { } b. No { }

Fruits and vegetables a. Yes { } b. No { }

Dairy a. Yes { } b. No { }

Fish, Meat and Alternatives a. Yes { } b. No { }

Fat and Sugar a. Yes { } b. No { }

Legumes a. Yes { } b. No { }

18. In the past 24 months did you feed your child/children age 24-59 months foods from any of these food groups?

Bread, Cereal and Potatoes a. Yes { } b. No { }

Fruits and vegetables a. Yes { } b. No { }

Dairy a. Yes { } b. No { }

Fish, Meat and Alternatives a. Yes { } b. No { }

Fat and Sugar a. Yes { } b. No { }

Legumes a. Yes { } b. No { }

19. Did you feed your child/children 6-59 months Vitamin A rich foods in the past 24 hours?

a. Yes { } b. No { }

If yes, please list them.....

20. Do you/did you attend the post-natal clinics with your child/children aged 6-59 months?

a. Yes { } b. No { }

If Yes, how frequent did you/do you attend the clinics.....

21. Did you learn any of the hygiene practices in PD HEARTH?

Wash hands before meal a. Yes { } b. No { }

Using sandal a. Yes { } b. No { }

Bathing a. Yes { } b. No { }

Tooth brushing a. Yes { } b. No { }

Nail-cutting a. Yes { } b. No { }

22. How frequent do you wash hands before meals?.....-

23. Do you still apply these positive behaviors practiced in PD HEARTH?

Increased feeding frequency including during and after being sick a. Yes { } b. No { }

If yes, how many times in a week?.....

Increased variety of food a. Yes { } b. No { }

If yes, how frequent?.....

Increased feeding a. Yes { } b. No { }

If yes, how many times in a day?.....

24. Do you still apply the care giving practices that were practiced in PD HEARTH?

Healthy snack a. Yes { } b. No { }

Making sure members of the family are involved in taking care of the children through good practice (ways practiced in PD Hearth) a. Yes { } b. No { }

25. Do you still apply the health seeking behaviors that were practiced in PD Hearth?

Increased number of post-natal visits a. Yes { } b. No { }

If yes, how many times in a month?.....

Take a child to health service provider when s/he is sick a. Yes { } b. No { }

If yes, how many times in a month?.....

26. Did your child receive diarrhea in the last two weeks?

a. Yes { } b. No { }

If yes how did you treat the diarrhea?

a. Homemade ORS { } b. Increased fluids { } c. Treatment in hospital { } d. Did nothing { }

IMPROVED LOCAL CAPACITY

27. Are the community health workers (CHWs) capable to operate PD Hearth at equal graduation rates without assistance?

a. Yes { } b. No { }

28. Are CHWs able to motivate participation?

a. Yes { } b. No { }

29. Are CHWs able to identify malnourished children?

a. Yes { } b. No { }

30. Are CHWs able to advocate for and secure community resources?

a. Yes { } b. No { }

31. Are CHWs/HWs and community members prepared enough (know enough about best practices and IYCF) to know what to look for during the Positive Deviance Inquiry (PDI)?

a. Yes { } b. No { }

32. Is the PDI producing clear enough strategies to adequately design PD Hearth program to address the underlying causes of malnutrition?

a. Yes { } b. No { }

33. Are the local health workers able to supervise the PD Hearth implementation?

a. Yes { } b. No { }

34. What behaviors changes learnt from the PD Hearth are CHWs promoting to the rest of the population?.....

35. As a community health work, what would be your possible response for the above questions?.....

COMMUNITY PARTICIPATION AND EMPOWERMENT

35. What do community leaders understand about the impact of malnutrition?

.....

36. What human resources have been contributed and what have been their roles?

.....

37. In what ways other than the PD Hearth programs are the community leaders engaged in improving health and nutrition?.....

38. In your opinion, do you think the PD Hearth program costs is being contributed to by the local government?

a. Yes { } b. No { }

If yes, approximately how

much.....

Please Record Any **additional Comments relevant** to the study from respondents and any

.....
.....
.....



Appendix 2: Interview Guide

Community Health Workers

1. Do you think PD Hearth intervention promote behavior change in the community?
2. Do PD Hearth intervention increase your understanding of child health issues?
3. Do PD Hearth intervention increase your understanding of food preparation?
4. Do PD Hearth intervention improve your understanding of good nutrition practices?
5. Do PD Hearth intervention enable you to collaborate better with community leaders?
6. Do PD Hearth intervention enable you to advocate for material support for future activities?

Area Chiefs






1. Do you know consequences of malnutrition?
2. Do you know about PD Hearth intervention in your community?
3. Are you committed towards success of the PD Hearth intervention?
4. Do you think your role is key to success of PD Hearth intervention?

Appendix 3: Study Site



(Source: World Atlas, 2014)

Study Sites

	→	Ntimaru
	→	Kegonga
	→	Thimlich
	→	Maroo
	→	Nyakune

Appendix 4: Consent Form

Hello,

My name is.....

I am a part of a research team assisting Calvince Anino of University of Eldoret to conduct research on Impact Evaluation of Positive Deviance Hearth Intervention in Migori County. University of Eldoret is committed to producing all round, competitive students who have skills to conduct research and disseminate the research findings. Thus, this exercise is part of the requirements for Calvince Anino to complete his MSc in Community Nutrition.

You are selected to participate in the study; your response will be COMPLETELY CONFIDENTIAL and will be added & analyzed together with those of other 59 persons. Participation is voluntary.

By participating in this survey, you will help Calvince Anino in meeting the requirements of the above MSc programme. In addition, the findings will be disseminated to the two host facilities in Migori County, Plan International Kisumu, APHIA Plus and World Vision IPAs to help in improving Positive Deviance Nutrition Education Program Approach and health outcomes of the society. If you wish to participate we may start:

Interviewer Name _____

Date of Interview _____

Appendix 5: Letter of Intent

Re: Request to Conduct Research in your Institution

This letter is to inform you of my desire to carry out a study from January 27th through February 28th on impact evaluation of Positive Deviance Hearth Interventions which were implemented between January and December 2013 in your institution. I am a second year MSc. student at the University of Eldoret and this study is part of my degree requirement.

Accompanying the letter are the research approvals by the ethics committee of National Commission for Science, Technology and Innovation, Ministry of Education and Migori County Commissioner.

I am well versed with the ethical guidelines recommended by the Kenyan government including the confidentiality of the information given by the participants as well as their anonymity.

Thanks in advance as I wait for your approval to carry the study in your institution.

Yours sincerely,

Calvince Anino

Appendix 6: Research Approvals

1. Research permit from NACOSTI
2. Approvals from the office of County Commissioner
3. Approvals from County Education Director