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SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

IMPACT OF FEED-THE-FUTURE PROGRAM ON MALNUTRITION AMONG CHILDREN IN THE NORTHERN REGION OF GHANA

BY

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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF **MSC. IN PUBLIC HEALTH MONITORING AND EVALUATION DEGREE**

OCTOBER, 2020

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DECLARATION

I, Apraku Edward Anane, declare that this work is the result of my original research under the supervision of Dr. Genevieve C. Aryeetey, and the inclusion of the other peoples' research by way of literature review has been duly acknowledged. This dissertation either in whole or in part has not been presented elsewhere for another degree.

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DEDICATION

I dedicate this study to my parents Ex-Sgt Joseph Mintah and Madam Elizabeth Mintah, My wife (Dorcas) and children (Nana K, Papayaw, K. Mensah, and Apraku Jnr)

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ACKNOWLEDGMENT

My warmest gratitude goes to the Almighty God for how far He has brought me through this journey. Special ovation to my supervisor, Dr. Genevieve C. Aryeetey for her massive contribution to this work. My next acknowledgment goes to the USAID Monitoring, Evaluation, and Technical Support Services especially Mr. Saaka Adams for releasing the Feed the Future Population data for my masters' dissertation analysis. My appreciation also goes to Dr. Kwaku Poku-Asante and Management of Kintampo Health Research Centre for providing funds for the sponsorship of my studies. My next appreciation goes to Dr. Sulemana Abubakari and Dr. Thomas Gyan for their support and encouragement. My appreciation would not be complete without acknowledging all the faculty members of the Department of Health Policy Planning and Management especially, Dr. Patricia Akweongo for their encouragement.

Lastly to all my colleagues who happen to be the first cohort of the MSc Public Health Monitoring and Evaluation program for their enormous contribution to the successful completion of the program.

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TABLE OF CONTENTS

DECLARATION ..... *i*
DEDICATION ..... *ii*
ACKNOWLEDGMENT ..... *iii*
TABLE OF CONTENTS ..... *iv*
LIST OF TABLES ..... *vii*
LIST OF FIGURES ..... *viii*
LIST OF ABBREVIATIONS ..... *ix*
DEFINITION OF TERMS ..... *xi*
ABSTRACT ..... *xiii*
CHAPTER ONE *1*
INTRODUCTION *1*
ns1.1 Background 1
1.2 Statement of problem 4
1.3 Research questions 6
1.4 Study Objectives 6
1.4.1 General Objective 6
1.4.2 Specific Objective 6
1.5 Conceptual framework 7
1.6 Justification 8
CHAPTER TWO *11*
LITERATURE REVIEW *11*
2.1 Introduction 11
2.2 Malnutrition trends in Africa 13
2.3 Malnutrition trends in Ghana 16
2.4 Determinants of malnutrition 17
2.5 Consequences of malnutrition 19
2.6 Feed the Future program as a social protection intervention 20
2.7 Targeting beneficiaries for social protection intervention 22
2.8 Impact evaluation approaches 24
2.9 Difference-in-difference method 26
CHAPTER THREE *33*
METHODS *33*
3.1 Study design 33

University of Ghana http://ugspace.ug.edu.gh

3.2 Study area 33
3.3 Study population 34
3.4 Inclusion/exclusion criteria 34
3.5 Study variables 35
3.5.1 Dependent Variable 35
3.5.2 Independent Variables 35
3.6 Definition of indicators 36
3.7 Sampling 37
3.7.1 Sample size determination 37
3.7.2 Sampling procedure 39
3.8 Data collection techniques 39
3.9 Quality control 39
3.10 Data process and analysis 40
3.11 Data analysis 40
3.12 Difference-in-difference analysis 43
3.13 Ethical Considerations 44
CHAPTER FOUR *45*
RESULTS *45*
4.1 Socio-demographic characteristics of household 45
4.2 Prevalence of Underweight, Stunting and Wasting at Baseline and Midline 48
4.2.1 Underweight 48
4.2.2 Stunting 49
4.2.3 Wasting 50
4.3 Factors independently associated with underweight at baseline 50
4.4 Factors independently associated with underweight at midline 52
4.5Adjusted logistic regression for factors associated with underweight at baseline 54
4.6 Adjusted logistic regression for factors associated with underweight at midline 54
4.7 Factors independently associated with stunting at baseline 56
4.8 Factors independently associated with stunting at midline 58
4.9 Adjusted logistic regression for factors associated with stunting at baseline 60
4.10 Adjusted logistic regression for factors associated with stunting at midline 62
4.11 Factors independently associated with wasting at baseline 63
4.12 Factors independently associated with wasting at midline 64
4.13 Difference-in-difference estimation for prevalence of underweight comparing baseline to midline 66

University of Ghana http://ugspace.ug.edu.gh

4.14 Adjusted difference-in-difference estimation for prevalence of underweight comparing baseline to midline 67

4.15 Difference-in-difference estimates for prevalence of stunting comparing baseline to midline 68

4.16 Adjusted difference-in-difference estimates for prevalence of stunting comparing baseline to midline 69

4.17 Difference-in-difference estimates for prevalence of wasting comparing baseline to midline 70

4.18 Adjusted difference-in-difference estimates for prevalence of wasting comparing baseline to midline 71

CHAPTER FIVE *72*

DISCUSSION *72*

5.1 Prevalence of underweight, stunting, and wasting 72

5.1.1 Prevalence of underweight 72

5.1.2 Prevalence of stunting 73

5.1.3 Prevalence of wasting 74

5.2 Factors independently associated with underweight 76

5.3 Factors independently associated with stunting 76

5.4 Factors independently associated with wasting 78

5.5 Impact of the FTF program on underweight 78

5.6 Impact of the FTF program on stunting 80

5.7 Impact of the FTF program on wasting 81

5.8 Strengths and limitations of the study 82

CHAPTER SIX *84*

CONCLUSIONS AND RECOMMENDATIONS *84*

6.1 Conclusion 84

6.2 Recommendation 85

REFERENCES *86*

University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

Table 1: Study variable of interest for the evaluation 35

Table 2: Definition of indicators 36

Table 3: Objectives and outcome measurement 37

Table 4: Background characteristics of household 47

Table 5: Factors independently associated with underweight at baseline 51

Table 6: Factors independently associated with underweight at midline 53

Table 7: Adjusted logistic regression for factors associated with underweight 54

Table 8: Adjusted logistic regression for factors associated with underweight at midline 55

Table 9: Factors independently associated with stunting at baseline 57

Table 10: Factors independently associated with stunting at midline 59

Table 11: Adjusted logistic regression for factors associated with stunting at baseline 61

Table 12: Adjusted logistic regression for factors associated with stunting at midline 62

Table 13: Factors independently associated with wasting at baseline 63

Table 14: Factors independently associated with wasting at midline 65

Table 15: Crude DID estimates for underweight 67

Table 16: Adjusted DID estimates for underweight 68

Table 17: Crude DID estimates for stunting 69

Table 18: Adjusted DID estimates for stunting 70

Table 19: Crude DID estimates for wasting 71

Table 20: Adjusted DID estimates for wasting 71

University of Ghana http://ugspace.ug.edu.gh

LIST OF FIGURES

Figure 1: FTF Result Framework 8

Figure 2 Graphical presentation of difference-in-difference estimator 28

Figure 3: Map of the FTF ZOI 34

Figure 4: Prevalence of underweight at baseline and midline 49

Figure 5: Prevalence of stunting at baseline and midline 49

Figure 6: Prevalence of wasting baseline and midline 50

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LIST OF ABBREVIATIONS

AfDB	African Development Bank
ANOVA	Analysis of Variance
ATT	Average Treatment Effect for the Treated
AU	Africa Union
BMI	Body Mass Index
CCT	Conditional Cash Transfer
CSV	Civil Society Organization
DID	Difference-in-difference
EAs	Enumeration Areas
FTF	Feed the Future
GDHS	Ghana Demographic and Health Survey
GHS ERC	Ghana Health Service Ethics Review Committee
GLSS	Ghana Living Standard Measurement Survey
GPRS	Ghana Poverty Reduction Strategy
GOG	Government of Ghana
GSS	Ghana Statistical Service
HH	Household
IDDS	Individual Dietary Diversity Score
IPs	Implementing Partners
ISSER	Institute of Statistical, Social and Economic Research
IT	Information Technology
IV	Instrumental Variables
KSU	Kansas State University
LEAP	Livelihood Empowerment Against Poverty
LOP	Life of Project
MAD	Minimum Acceptable Diet
METSS	Monitoring, Evaluation, and Technical Support Services
MMDAs	Metropolitan, Municipal and District Assemblies
MoGCSP	Ministry of Gender, Children and Social Protection
NGO	Non-Governmental Organization
NSPS	National Social Protection Strategy
OECD	Organization for Economic Co-operation and Development

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PAMSCAD	Program of Actions to Mitigate the Social Costs of Adjustment
PBS	Population Base Survey
PEM	Protein Energy Malnutrition
PPS	Probability Proportional to Size
PSM	Propensity Score Matching
RING	Resiliency in Northern Ghana
RD	Regression Discontinuity
SD	Standard Deviation
SPRING	Strengthening Partnerships, Results, and Innovation in Nutrition Globally
SSA	Sub-Saharan Africa
USAID	United States Agency for International Development
UNICEF	United Nations Children's Fund
WASH	Water access, Sanitation, and Hygiene
WHO	World Health Organization
WRA	Women of Reproductive Age
ZOI	Zone of Influence

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DEFINITION OF TERMS

Underweight	Underweight refers to a child who is low weight for his or her age
Stunting	Stunting refers to a child who is too short for his or her age
Wasting	Wasting refers to a child who is too thin for his or her height.
Outcome	The likely or achieved short-term and medium-term effects of an intervention's output
Output	The products, capital goods, and services which result from a development intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Effect	Intended or unintended change due directly or indirectly to an intervention
Efficiency	A measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Effectiveness	The extent to which the development intervention's objectives were achieved, or are expected to be achieved, taking into account their relative importance
Counterfactual	The situation or condition which hypothetically may prevail for individuals, organizations, or groups were there no development intervention
Impact	Positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended
Indicator	Quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect the changes connected to an intervention, or to help assess the performance of a development actor.
Mid-term evaluation	An evaluation performed towards the middle of the period of implementation of the intervention
Results	The output, outcome or impact (intended or unintended, positive and/or negative) of a development intervention.
Result Framework	The program logic that explains how the development objective is to be achieved, including causal relationships and underlying assumptions.

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Social Protection	Refers to "all public and private initiatives that provide income or consumption transfers to the poor, protect the vulnerable against livelihood risks and enhance the social status and rights of the marginalized; with the overall objective of reducing the economic and social vulnerability of poor, vulnerable and marginalized groups" (Devereux & Sabates-Wheeler, 2004)

Source:(Devereux & Sabates-Wheeler, 2004; OECD-DAC, 2010)

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ABSTRACT

Introduction: Malnutrition among children under-five years old is still a major challenge in most developing countries. Efforts geared towards its prevention or reduction should be given the needed attention. Ghana is one of the 30 countries benefiting from the U.S. government Feed the Future (FTF) initiative in fighting global poverty and hunger. The fundamental aim of developmental agencies, governments, and donors globally, is to 'make a difference' in the lives and wellbeing of people and society. The need to ensure that resources are used efficiently and effectively becomes imperative as they tend to establish cause and effect of interventions.

Objectives: The objective of the study was to evaluate the impact of the FTF program towards the reduction in malnutrition (underweight, stunting, and wasting) in children under-five years old in the Northern Region of Ghana.

Methods: Secondary data from the MESTSS PBS 2012 and 2015 were obtained and used for the analysis. The data was imported into Stata version 15.0 for analysis. Logistic regression was done to find correlates of malnutrition. Difference-in-difference estimator model was used to establish the impact of the FTF program in the reduction of malnutrition.

Results: For the effect of FTF program, underweight and stunting increased by 0.5 percent (p-value=0.803) and 0.1 percent (p-value=0.988) respectively, whilst there was -0.3 percent (p-value=0.868) reduction in wasting after adjusting for other covariates.

Conclusion: Although there was a -0.3 percent reduction in wasting after adjusting for covariates, the change was not statistically significant (p-value=0.868). Hence at a significance level of 5 percent, there was not enough statistical evidence to conclude that the FTF program caused the reduction in wasting at midline. The results of this evaluation would provide evidence to inform evaluation research, and would provide the implementation teams and stakeholders the opportunity to review and strengthen the monitoring and evaluation activities in order to meet the set objectives.

Key Words: impact evaluation, malnutrition, underweight, stunted, wasted, difference-in-difference

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CHAPTER ONE

INTRODUCTION

1.1 Background

The fundamental aim of most developmental agencies, governments, and donors globally is to 'make a difference' in the life and wellbeing of people and society. In order to realize this achievement, there should be conscious efforts to provide metrics or data to quantify the change as aspired (Eliza & Anyangwe, 2013). Various development agencies across the globe support and provide interventions which are targeted at a particular group or society, often viewed as vulnerable or chronically poor. These agencies are often referred to as Non-profit or Non-Governmental Organization (NGOs), Civil Society Organization (CSV) among others. Others prefer to refer to them as development partners since they complement government efforts in providing societal needs (Corry, 2010). The need to ensure that resourced/funds are efficiently and effectively used becomes imperative for these developmental agencies across the globe as issues of accountability is valued by funders or donors. This could be achieved where funds invested in projects are evaluated periodically.

Evaluation is the "the systematic and/or objective assessment of an on-going or completed project, program or policy, its design, implementation and results" (OECD, 2010). The purpose of the evaluation is to be able to determine the significance and achievement of set objectives, efficiency in the use of resources, effectiveness of the system, impact, and sustainability of the intervention (OECD, 2010).

Outcome measurement or impact evaluation is a management tool which provides project leaders the opportunity to query their structures and activities towards the achievement of organizational objectives. Impact as defined by OEDC-DAC (2010) is the "positive and negative, primary and secondary long-term effects produced by a development intervention,

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directly or indirectly, intended or unintended" (OECD-DAC, 2010). By the above definition, the impact could be seen as the benefit which is realized at the population level by the end-users or by those whom the intervention is targeted. Impact evaluation often distinguishes between between rhetoric and evidence-based change. It tends to provide answers to what would have been the realization of the outcome without the intervention. In the absence of the program what would have happened? Could positive product or change within those who enjoyed the program be attributed directly to a project? (Bedi et al., 2006; Eliza & Anyangwe, 2013).

Ghana is not an exception in terms of efforts by not-for-profit and or civil society's contribution towards its development in the country's poor resource areas. The United States Agency for International Development (USAID) has been phenomenal in promoting health and wellbeing through projects in the various regions and district through a partnership with the government of Ghana. Ghana happens to be among the USAID Feed-the-Future (FTF) program as part of the global hunger and food security initiative instituted by the U.S. Government. The initiative try to find solutions to the root causes of poverty, hunger, malnutrition and transforming lives (J. G. Cooke, Green, & Spear, 2018; Zereyesus, Ross, Amanor-Boadu, & Dalton, 2014).

The FTF program is an integrated project and partnership effort under USAID's FTF program designed to contribute to the Government of Ghana's efforts to sustainably reduce poverty and improve the nutritional status of vulnerable populations (METSS-Ghana, 2012). The objective of the FTF program is to improve the livelihoods and nutritional status of vulnerable households in targeted communities of seventeen districts in the Northern Region. This are three complementary project mechanisms designed to ensure the achievement of the initiative: to improve behaviors associated to nutrition and hygiene of women and young children, to increase diverse quality food consumption with focus on

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women and children; and to strengthen capacities in local support networks to mitigate the current needs of vulnerable households. The FTF program is executed in close harmonization with USAID, the Metropolitan, Municipal or District Assemblies (MMDAs), Northern Region Coordinating Council, and the Northern Regional Health Directorate (J. G. Cooke et al., 2018; METSS-Ghana, 2012)(J. G. Cooke et al., 2018; Global Communities, 2018).

Targeting and distribution of designated services to beneficiary vulnerable communities and households were conducted by the seventeen MMDAs, while Global Communities and its associated implementing partners were responsible for providing technical assistance, and developing MMDA's capacity to deliver and maintain the activities promoted under the FTF program. There are various indicators of the FTF program but for the purposes of this evaluation, the focus is on the effect of malnutrition among children under-five years old. Specifically evaluating the reduction in stunting, underweight, and wasting as the indicators of interest.

Malnutrition in children under-five years old remains a challenge in many developing countries. Current estimates reveal that 25 million children are stunted and overweight or stunted and wasted globally (Hawkes, 2018). The Global Communities 2018 quarterly reports suggest an improvement in the performance indicators for malnutrition among children (under five years old) at midline since the start of the FTF program in Ghana comparing baseline and midline data (Global Communities, 2018). It is worth to evaluate whether the suggested improvement in the reduction realized in the three indicators at midline could be attributed to the intervention provided by the FTF program.

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There are eleven baseline indicators to measure economic and health conditions in the FTF ZOI. The indicators are categorized into four components: (1) Economic wellbeing; (2) Anthropometry measurement of women and children; (3) Diet diversity and hunger, and lastly (4) Empowerment of women in the ZOI. Due to time constraint, the emphasis of this evaluation is focused on the health conditions of children looking at their nutritional characteristics and the impact of the FTF on their lives. (Zereyesus et al., 2014).

1.2 Statement of problem

Malnutrition continues to remain as a major global public health concern, contributing to about 45 percent of deaths in under-five children (WHO, 2019). According to the 2018 Global Nutrition report, "malnutrition is unacceptably high and affects every country in the world" (Global Nutrition Report, 2018). Malnutrition is a widespread problem which affects many populations of the world from infancy to old age, without regard to gender and wealth status (Global Nutrition Report, 2018). Children who suffer from severe acute malnutrition die easily from common childhood illness such malaria, pneumonia, and diarrhoea (WHO, 2019). Children from Africa and Asia suffer the highest of all forms of malnutrition, for instance, more than one-third of all stunted children, more than one-quarter of all the wasted children were found in Africa in 2018 (UNICEF/WHO/World Bank, 2019). In Ghana, malnutrition is highest in the northern region compared to the other regions (MICS, 2017).

Despite efforts and interventions to reduce malnutrition in the northern part of Ghana, malnutrition among children continue to soar in these areas (Amoaful, 2016). Malnutrition affects mostly children under five years old and is a substantial indirect cause of child death, responsible for one-third of all childhood mortality in Ghana. In Northern Ghana particularly, evidence suggest that, two out of every five children suffer from stunting and above 80 percent of them suffer from anemia (UNICEF, 2015).

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The causes of malnutrition in children stem from factors such as food insecurity, poor child and maternal care and poor nutrition coupled with seasonal weather variations especially in the northern part of Ghana (Ministry of Health, 2009). Apart from the above, there are other factors such as maternal, household, and community characteristics that contribute to malnutrition in under-five children (Glover-Amengor et al., 2016).

Consequences of malnutrition have a detrimental effect on the cognitive development of children under-five years old which affects them entirely in their life (Aheto, 2019; MOH/GHS, 2013). Children who are suffering from stunting have tendencies of not attaining their expected height and their brains may have developmental defects which will affect their cognitive budding (Shekar et al., 2017). As a result, malnourished children suffer from the venom of malnutrition which may have the propensity to deny them their full intellectual development function and reduced them to low performance in education, productivity and poor livelihood standard (African Union, 2015). The above presupposes that there are both health and economic consequences of the problem which needs to be addressed.

In response to this, the USAID introduced an intervention known as the Feed the Future program with the aim to reduce global hunger, build resilience in vulnerable households and thereby reduce malnutrition in the Northern region (Zereyesus et al., 2014). The program has been in existence from 2012 and ended in 2018. This study sought to assess the impact of the FTF program in reducing malnutrition in children under-five years old in the ZOI (METSS-Ghana, 2012; Zereyesus et al., 2014). In order to realize the contribution of the FTF in their quest to reducing malnutrition in the ZOI, it has become necessary to apply statistical techniques to estimate the real impact of the program. This study was motivated

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by the above and also would provide the implementing bodies and stakeholders the chance to assess the progress of the intervention.

1.3 Research questions

The following questions are set out to be answered by the study:

1. What is the prevalence of malnutrition (stunting, underweight, and wasting) in the Zone of influence of the Feed the Future intervention?
2. What are the independent factors associated with stunting, underweight, and wasting in the Zone of influence?
3. What is the impact of the FTF program on reducing malnutrition (stunting, underweight, and wasting) in children under-five in the intervention?

1.4 Study Objectives

1.4.1 General Objective

To evaluate the impact of the Feed the Future program on nutritional status of children in the Northern region of Ghana.

1.4.2 Specific Objective

1. To estimate the proportion of children under five who are underweight, stunted, and wasted.
2. To identify factors independently associated with stunting, underweight, and wasting.
3. To estimate the impact of Feed the Future program on stunting, underweight, and wasting in children under five years in the FTF ZOI

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1.5 Conceptual framework

This study adopts the results framework of the FTF program (Zereyesus et al., 2014). The FTF result frameworks provide the relationship between the objectives of the program and factors that influence the achievement of the objectives. When there is an inclusive growth in the agriculture sector, the nutritional status of women together with their children may improve. Women and their children may benefit from the produce from the farms and may improve their nutritional status.

The improvement of agricultural productivity, expanded market and trade, increased in agricultural and nutritional activities, and increased employment opportunities in targeted value chain may lead to an inclusive development in the agricultural sector. When the inclusive development in the agricultural sector is achieved, it may also lead to a reduction in under five mortality. On the other side of the framework, having better access to different and quality foods, better quality nutritional related behavior(s), and improving the use of maternal and child health and nutrition services may lead to an enhancement of nutritional status of women and their children (Boadi & Kobina, 2017; Onyeneke et al., 2019.).

The improvement of women and children's nutritional status if accomplished may also lead to a reduction in under five mortality. Inclusive growth in the agricultural sector may also lead to an improvement of nutritional status of women and children and vice versa. Augmented resilience of households and vulnerable communities may also lead to inclusive growth in the agricultural sector which would in turn have impact on the nutritional status of women and their children. All the above would also increase employment opportunity in the targeted value chain as the youth, women and all those involved in agriculture will be engaged productively.

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Improving access to diverse and quality food would also provide households the opportunity to make choices to improve their health rather than depending on a particular food type all the time. When women are introduced to improved nutrition-related behaviors and improve nutrition services, maternal and child health, they will get to know how to diversify the consumption of food to provide them different ration of nutrients necessary for the body's metabolism, especially for children to grow.

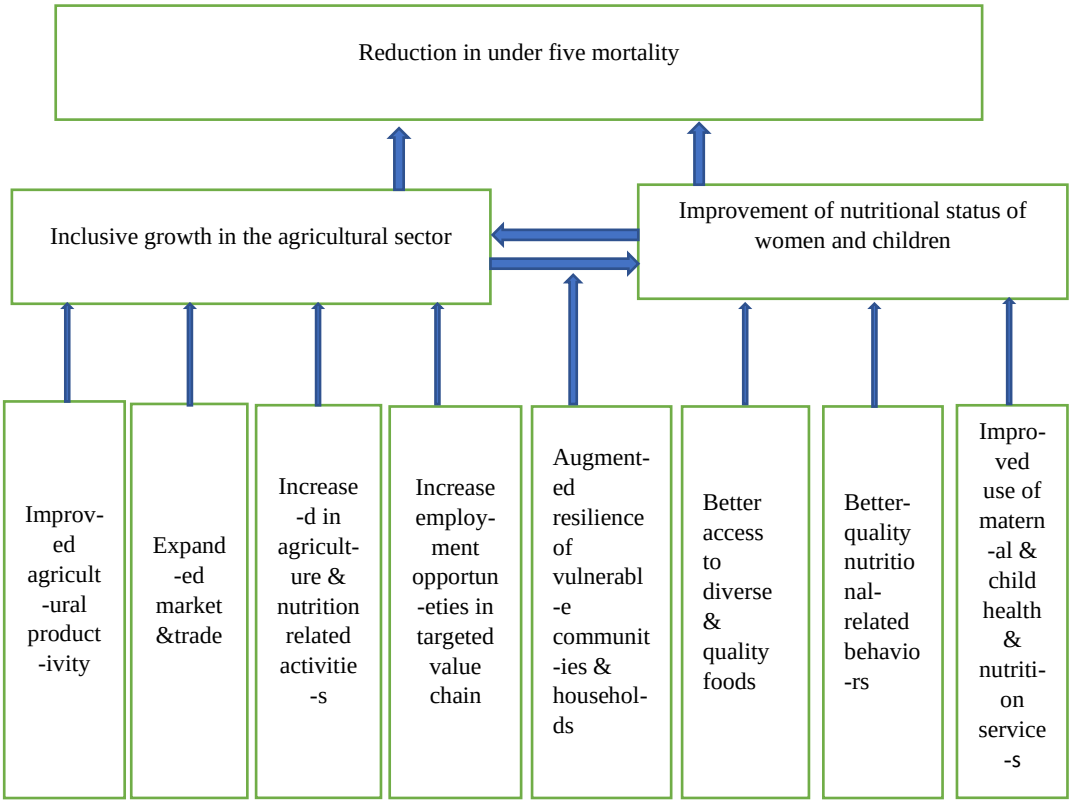

Figure 1: FTF Result Framework
Adapted from the USAID result framework 2013 as cited in Baseline Indicators for Northern Ghana, 2012 (Zereyesus et al., 2014)

1.6 Justification

Global development projects or interventions are only as important or good as the impacts they produce, and this could only be achieved through rigorous efforts in measuring the effect of the outcome at the population level (Eliza & Anyangwe, 2013).

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This study aimed to evaluate the impact of the USAID FTF program towards a reduction in malnutrition in children under-five years old by controlling for other covariates using a Difference-in-difference (DID) analysis (Lechner, 2011).

As resources continue to depreciate given the global economic recession (Havemann, 2010), it has become imperative to develop strategies that will ensure value for money. When resources are invested in programs, the challenging aspect becomes the quantification of the impact of the program at the population level. This is not without implementation challenges coupled with limited or no funds for continuity.

From the objectives of the Africa Impact Evaluation Initiative (2007) which seeks to; address clients' demand for better use of resources, build capacity to learn what works in the government sector, provide support for the implementation of projects and lastly to contribute to knowledge building, it is imperative to learn and build domestic capacity with the requisite techniques, tools, and applications used in evaluation exercises (Legovini, 2007). Evaluating the impact of the FTF program is also justified since it will suggest ways for improving the effectiveness and efficiency of the project.

Fiona Halton, a chief executive of Pilotlight (2013), in a report said that embarking on this (evaluation), charitable organizations can strengthen their relationship with funders. According to Halton, having impact evaluation in place, charitable organizations could make better use the scarce resources and make the biggest difference to their beneficiaries (Halton, 2013). Providing donors, the opportunity to have feedback on the effect of development programs will foster donor and program partner relationship which may breed effective communication among them.

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Also, funders would have a fair idea of the matters arising and the progress as they become aware of what interventions are working and where resources should be concentrated. Also, research or evaluation waste would be minimized since information collected is analyzed and disseminated among stakeholders.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Malnutrition is the inadequate or deficiency or excess intake of energy or nutrients to meet the daily nutritional requirements of an individual (MCN, n.d.; WHO, 2016). Malnutrition underlies micronutrient deficiency (Global Nutrition Report, 2016). It is characterized by stunting, wasting which is also referred to as thinness, and underweight. Underweight is characterized by deficient weight for age; stunting is described as insufficient height for age; and wasting as an insufficient weight for height (Academy of Nutrition and Dietetics, 2017; Onis & Blössner, 2016).

The inverse of undernutrition is overnutrition, both of them come together to cause what is called malnutrition (Atsu, Guure, & Laar, 2017; Masibo, 2013). Malnutrition is sometimes or usually described as undernutrition. The latter can be caused by a lack of calories, protein, or other nutrients. This is prevalent in areas of the world characterized by inadequate access to food and clean drinking water (Academy of Nutrition and Dietetics, 2017). Since nutritional inputs are necessary for the growth of every child, there is the need to look at malnutrition critically as it can hamper the cognitive development of malnourished children (World Bank Group, 2018). Undernutrition and overnutrition both tend to cause deprivation in children and eventually lead to the deaths of many children (Atsu et al., 2017).

The World Health Organization (2005) defines undernutrition as “the cellular imbalance between the supply of nutrients and energy and the body’s ability to utilize it for growth and the maintenance of specific functions, including resistance to infections and recovery from illness”. Anomalies in the growth of children are pointers of undernutrition, this is because, how children are fed translates into how they grow (Robinson *et al*. 2001).

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Generally, the fundamental way to establish that a child is malnourished is by comparing or measuring the weights and heights (lengths) of children at 0 to 59 months with the distribution of marked weights or heights measured against an assumed healthy population of children of similar features (same age and sex). This is achieved by establishing the z-scores of the population in question, that is, the difference between the children whose anthropometry measurements (weight, height) are taken, and the median value at a specific age bracket and sex in the reference cohort, divided by the standard deviation (SD) of the cohort (Caulfield, Richard, Rivera, Musgrove, & Black, 2002) (Emily Bloss, Fidelis Wainaina, 2004).

A child with a height-for-age is <2 SD is measured as stunted; this is because the child's chances his or her height becoming normal is less than 3 percent. Any child with <2 SD weight-for-age is measured as being underweight. Wasting is also classified as any child with weight for height <2 SD (Caulfield et al., 2002). When undernutrition persists for overtime, the resultant effect is stunting. Stunting retards the continuous growth of a child, whereas wasting emanates from insufficient nutrition over a shorter period (Caulfield et al., 2002). Underweight involves both stunting and wasting. Children begin to have a problem with growth when they are introduced to solid food from six months of age. During this transition period, exposure of children to the environment increases thereby increasing the possibility of being infected with certain illnesses is(Caulfield et al., 2002).

According to the Joint UNICEF/WHO/World Bank (2018) report, about 22.2 percent of children under five years old are stunted. This shows a global reduction from 39.5 percent in 1990 to 22.2 percent in 2017. About 7.5 percent of children under-five years old were reported wasted or moderately wasted and 2.4 percent were severely wasted as of 2017.

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Conversely, overweight saw an increase from 5 percent in 1990 to 5.6 percent in 2017 (UNICEF/WHO/World Bank, 2018).

The 2018 UNICEF/WHO/World Bank is quoted to have reported that "Africa and Asia bear the greatest share of all forms of malnutrition, explaining that, more than half of all the under-five children stunted globally lived in Asia and more than one third lived in Africa in 2017". Similar findings were reported for wasting and overweight. According to the report, more than two-thirds of all children under five years old who were considered wasted globally came from Asia, and more than one quarter was found in Africa in the same year (UNICEF/WHO/World Bank, 2018). The burden is high in Asia and Africa and efforts must be made to curb the situation

From the 2008 Ghana Demographic and Health Survey (GDHS), about 28 percent of Ghanaian children who are under-five (<60 months) are stunted. The report reiterates that 7.5 percent was also wasted, and about 13.9 percent were underweight. The national trend for malnutrition, especially stunting in children under-five saw a drop from 35 percent in 2003 to 28 percent in 2008, despite the national drop stunting rates in the northern part of Ghana remained high with an increase in some regions (GDHS, 2008).

2.2 Malnutrition trends in Africa

Africa appears overburdened with malnutrition. Even though there was a reduction in stunting between 2000 and 2017 globally, stunting continued to increase mainly in SSA. A Joint report by UNICEF/WHO/World Bank on malnutrition in 2018 indicated that more than one-third of all under-five children who were stunted lived in Africa; one-quarter of overweight children under-five, and one-quarter of all wasted children under-five were also resident in Africa (UNICEF/WHO/World Bank, 2018).

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Also, the Global Panel report (2016) showed that malnutrition is increasing across the African continent, mainly in sub-Saharan Africa (SSA). The number of stunted children under five was rising by 500,000 every year in SSA. The report argued that there will be two-hundred and sixteen million undernourished individuals in SSA by 2030 if the situation continued (Global Panel on Agriculture and Food Systems for Nutrition, 2016).

Furthermore, Abdi Latif Dahir (2017) is quoted to have said, "Africa is the only continent in the world where children are both fat and stunted" (Dahir, 2017). This assertion implies that malnutrition has a double burden effect on Africa's children which could be attributed to the absence of the required food nutrients necessary to improve the growth of children. As a result of the chronic malnutrition in Africa, more than 30 percent of children suffer from certain forms of growth disorders such as stunting. This disorder has serious implications on the physical and cognitive/mental development of African children (SOS CHILDREN'S VILLAGES, n.d.).

African regional strategic report on nutrition 2015 by the Africa Union (AU), suggested that malnutrition contributes to poverty and as a result, the impoverished individuals tend to have reduced options for livelihood due to increased likelihood of illness, low educational attainment and reduced productivity (African Union, 2015). A World Bank report in 2018 appears to affirm AU's position. This is because Africa, especially, SSA lagged behind the global progress towards the reduction of poverty and unlike the rest of the world, poverty is rather increasing. The report showed that 27 out of the 28 world underprivileged countries were found in SSA (all with poverty index above 30 %) (World Bank, 2018).

Moreover, half of the multi-dimensionally poor countries in SSA suffer from different forms of deficiencies in consumption, education, and access to certain elementary infrastructure

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services (World Bank, 2018). Luchuo Engelbert Bain et al. (2013) noted that individuals tend to have a long term effect of persistent malnutrition, and this may further hamper economic and social development that keeps them in a vicious cycle of poverty (Luchuo Engelbert Bain et al., 2013). The futuristic effect of malnutrition in children, especially, African children and its overwhelming effect on their cognitive development cannot be overemphasized (J. M. K. Aheto, Keegan, Taylor, & Diggle, n.d.; Luchuo Engelbert Bain, Paschal Kum Awah et al., 2013; Masibo, 2013). Good nutrition promotes cognitive development, provides better prospects for children to achieve their potential, and a good environment for higher incomes later in life (Keeley et al., 2019).

There have been efforts by African leaders towards the reduction of malnutrition in the region over the years, especially between 2000 and 2015 (African Union, 2015;WHO, 2017). Records showed that almost all the African nations recorded a reduction in malnutrition albeit there are clear indications that no African country is near reaching the global WHO 40 percent target of reduction malnutrition by 2025 (Osgood-zimmerman et al., 2018). Considering the vase evidence of the irreversible effect of malnutrition on the mental or cognitive development of children, efforts should be made to mitigate this ‘cancer’ in African children (Glover-Amengor et al., 2016).

Retarded growth during childhood has implications for health outcomes and an increased risk of infant and child mortality (Osgood-zimmerman et al., 2018). If the improvement of reduction in malnutrition as discussed above continue without falling, then, most Africa countries would not meet the WHO global targets 2025. Considering current rates, most African countries if not all of them will not be able to meet the Sustainable Development Goal target aimed at ending malnutrition by 2030 (Osgood-zimmerman et al., 2018).

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2.3 Malnutrition trends in Ghana

Dr. Akinwumi Adesina (AfDB, 2016) is quoted to have said "Nutrition fuels grey matter infrastructure, the minds of the next generation that will drive progress and innovation. If we do not act, we will fail to unleash the full potential of millions of people around the world" (ADFSN, 2016). He believed that leveraging on nutrition can spur economic growth and should not be seen as only for health and social development. The then President of Ghana, H.E. John Kufuor who happened to co-chair the event emphasized the need to reshape food systems to prioritize nutrition since the consequences will be a tendency to have a weaker and fragile future**.** He added that "Nutrition is not about just feeding people, it is about powering life and the growth of individuals, communities, and nations," (ADFSN, 2016).

Despite the importance of nutrition for children, the Ghana Statistical Service (GSS) in 2011 reported that about 13 percent of children under five years old in Ghana were somehow or sternly underweight, and about 3 percent were classified as sternly underweight or too thin for their age. Also, about 23 percent of the monitored children were somehow or sternly stunted or they were too short for their age, and 7 percent were sternly stunted. Also, the report observed that about 6 percent of the children under-five years old were somehow or sternly wasted or too thin for their height (Ghana Statistical Service, 2011).

The regional variations of malnutrition in Ghana are characterized by socio-economic and environmental factors. One's socioeconomic status and place/region of residence affect the level of severity of malnutrition in Ghana. According to the GSS 2011 report, children who lived in the Northern and the Upper East regions were more probable to be underweight and stunted compared to their cohorts in other regions. On the other side, the proportion of children who were wasted was highest in the Upper West and Volta regions. The report

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noted that the proportion of children who were underweight and stunted was higher in the rural compared to the urban areas (Ghana Statistical Service, 2011).

A baseline study by Saaka et al, (2015) in 2013 in the three northern regions to estimate the prevalence of malnutrition found that the proportion of children who were wasted was 12.5 percent; those suffering from the severe form of thinness was 2.2 percent, which slightly exceeds the 2 percent WHO cut-off point. Also, those considered to be stunted was 23.2 percent. (Saaka, Larbi, Hoeschle-zeledon, & Appiah, 2015). The study concluded that children who were less than 2 years old in northern Ghana were at risk of not meeting the infant feeding standards propagated by WHO. This is because less than 50 percent of those children were on a minimum acceptable diet (Saaka et al., 2015).

Following the above development, the approach or measures to improve malnutrition in the three northern regions of Ghana should be concerted and determined given other deprivation conditions that prevail in the regions (UNDP, 2018). There is a need for policymakers, implementers of various social policy or protection programs, and the central government to collaborate in finding an ending solution to the problem (Abebrese, 2011). The ability of these children to develop sufficient mental or cognitive capabilities is questionable given the evidence that underpins the relationship between malnutrition and cognitive development (Kar, Rao, & Chandramouli, 2008; Morgan, 2015). Therefore, it is imperative to guarantee that children have an acceptable nutritional diet since it promises a healthy and productive generation or population in the future (Boadi & Kobina, 2017).

2.4 Determinants of malnutrition

There are many different causes of malnutrition in children under five years old globally. Factors such as access to safe drinking water, sanitation and cleanliness, income, education,

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and quality health services are documented to influence malnutrition (Kwami, Godfrey, Gavilan, Lakhanpaul, & Parikh, 2019; WHO, 2015). Inadequate feeding of children or breastfeeding for babies is considered as the underlying cause across all facets of malnutrition (Global Nutrition Report, 2018).

According to the Global Nutrition Report (2018), "Poor diets are the second-leading risk factor for deaths and DALYs globally, accounting for 18.8 percent of all deaths, of which 50 percent are due to cardiovascular disease" (GBD, 2015; Global Nutrition Report, 2018). Insufficient intake of food and lack of nutritional knowledge is classified to be major causes of malnutrition. This is because the majority of children do not know the content of what they take daily and risk being malnourished (Khan et al., 2017).

Several risk factors may account for malnutrition in children. In a study conducted in Burkina Faso, Poda et al. (2017) found sex of the child, age, size of the baby at birth, child morbidity, education level of mothers and their BMI, and wealth index of households to be associated with malnutrition. (Poda, Hsu, & Chao, 2017). In a study conducted in the Palpa district of Nepal, the status of children nutrition and education of the child's mother, immunization status, exclusive breastfeeding, sex of children, place of delivery were found to be associated with malnutrition (Karki, Bose, & Singh, 2017).

In the multivariate analysis of the 2014 GDHS, Acquah et al. (2019), identified age of child, household wealth status, mother's age, education level of mother's and health insurance subscription to be associated with underweight significantly in the children (Acquah, Darteh, Amu, & Adjei, 2019). In another study conducted in Nigeria, Babatunde et al. (2011) found an association between age and gender of the child, mother's education level and nutritional status, clean water, and toilet and malnutrition in children under five (Babatunde, Olagunju, Fakayode, & Sola-Ojo, 2011).

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In a current study conducted by Tekile et al. (2019) in Ethiopia, age of child, place of residence, education level of mothers, wealth index of household, sex of the child, type of toilet facility, size of a child, mothers' body mass index and the number of children per household were associated with stunting. With underweight, similar variables were found to be associated significantly, all the factors mentioned above were found to be associated with underweight except BMI of mothers. Apart from the above, water facility was also found to be associated with underweight. The following individual factors were also found to be associated with wasting; water facility, size of family, age of child, sex of a child,' education level mothers, place of residence, wealth index of a household as demonstrated by Tekile et al (Tekile, Woya, & Basha, 2019)

2.5 Consequences of malnutrition

Malnutrition is a cardinal global and public-health concern and noted to increase the risk of death and sickness in children under-five years old (Osgood-zimmerman et al., 2018). It is a foremost public health problem and responsible for nearly half of all child deaths worldwide (UNICEF, 2019). It is both a health consequence and a risk factor for childhood diseases such as malaria, diarrhea, pneumonia (MOH/GHS, 2013). Also, it continues to be a principal cause of more ill-health than any other cause (Global Nutrition Report, 2018).

For most developing countries, there are significant negative consequences of malnutrition, this tends to affect them in the areas of poor human health, loss of human capital, and reduced economic productivity (Oot, Sethuraman, Ross, & Diets, 2016). Malnutrition has extensive effects and includes prolonged recovery after illness and a long stay at the hospital (Drahansky et al., 2016). It increases the risk of disease and death in children, practitioner visits, and an increased likelihood of being referred to tertiary facilities (Drahansky et al.,

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2016). Malnutrition in children affects the cognitive development of children and may affect them in their future life (MOH/GHS, 2013). Some of the reported common signs of malnutrition include; inadvertent weight loss, loss of appetite, low body weight, feeling of fatigue, body weakness, improper growth of Child (A. Khan et al., 2017).

According to Morgan et al. (2015), "the impacts of chronic malnutrition are most severe during early childhood when the majority of brain development occurs, making it imperative to prevent early on in life" (Morgan, 2015). The consequence of acute protein energy malnutrition (PEM) in children under five which causes stunting and wasting could also affect the ongoing growth of higher cognitive procedures during childhood (Kar et al., 2008). Effects of severe malnutrition can result in increased morbidity and mortality in children, and as a result lead to impaired psychological and intellectual development (Akombi et al., 2017).

2.6 Feed the Future program as a social protection intervention

The aim of the USAID FTF program practically entrenches itself in the provision of social protection by promoting increasing resiliency in the FTF ZOIs. The FTF program is a good example of a social protection program which aims at increasing food insecurity, empowering women, improving the nutritional state of women and children through diversification of women dietary behaviours with an overall aim of finding solutions to the root sources of poverty, malnutrition, and starvation. These programs target the poor, vulnerable and or the chronically poor.

The Northern (the Northern, Upper East, and Upper West regions) part of Ghana according to the Ghana Poverty and Inequality Report (2016) continue to soar in the poverty rates (Cooke et al, 2015). The report acknowledges that there has been substantial progress since

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2006. For instance, the level poverty dropped from 72.9 percent in the Upper East region in 2006 to 44.4 percent in 2013. Conversely, the Northern region experienced a marginal fall from 55.7 percent to 50.4 percent even it recorded the highest level of poverty (E. Cooke et al., 2015). The Northern region has continually experienced the lowest achievement in the reduction of poverty since the 1990s. According to Cooke, this is a serious problem for the country since the Northern region currently constitute the largest number of poor and disadvantage people than any part of Ghana's ten regions (1.3 million) (Cooke et al., 2015).

The FTF program in the Northern region of Ghana is not a misplaced priority since the region has documented proof of underdevelopment. Targeting the region in terms of developmental interventions which provides resilience and relieve could help improve and manage the shocks that may pertain in various homes as drought and other physical conditions continue to affect lives in the region. In order to realize the overall goal of the USAID FTF program, USAID together with the Government of Ghana and relevant stakeholders conduct standalone projects in the FTF ZOI. Among the many social protection programs undertaken by the USAID FTF program, the Resiliency in Northern Ghana Project (RING) and the Strengthening Partnerships, Results, and Innovation in Nutrition Globally (SPRING) project were aimed at fighting malnutrition especially in women and children under five (Global Communities, 2018; SPRING/Ghana Project, n.d.).

According to the RING quarterly report (2018), the RING project was a poverty reduction-oriented program intended to improve the nutritional state and income status of disadvantaged households and had seen tremendous progress towards the achievement of its objective. This was achieved by using a multi-sectorial approach to surge resiliency of these households by promoting agriculture, creating income generation avenues,

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encouraging savings and loans, enhance nutrition, Water, Sanitation and Health (WASH), and good governance interventions (Global Communities, 2018).

The objectives of the standalone USAID FTF program could be identified with the various dimensions as prescribed by Devereux and Sabetes-Wheeler (2004). Devereux and Sabates-Wheeler (2004) were of the view that social protection could be categorized under the following types namely; preventive, promotive, protective and transformative measures of social protection. They argued that social protection programs may fall under one of the categories though others may overlap due to their description (Devereux & Sabates-Wheeler, 2004).

2.7 Targeting beneficiaries for social protection intervention

Targeting or selecting beneficiaries for social protection interventions such as the FTF program may have its own pros and cons. Mkandawire (2005) identifies ‘‘Universalism’’ and or selectivity through “targeting” as the essential principle underpinning social provisioning (interventions) in society. He was of the view that under “universalism”, the population as a whole is the target beneficiary of the social benefits as a fundamental right, while “targeting” requires meeting an eligibility criterion to identify the “truly deserving”(Mkandawire, 2005).

During the 1960s and 1970s, the focus of social provision was universalism but this saw a change towards targeting the “deserving poor” in both the developed and developing countries. Mkandawire (2005) observed that efforts were made to redesign and re-conceptualize many social welfare policies and interventions in order to constrict undeserving beneficiaries. Targeting of beneficiaries became dependent on meeting certain level of criterion through “means tests, income tests, claw back taxes, diagnostic criteria,

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behavioral requirements, and status characteristics" as demonstrated by Mkandawire (Mkandawire, 2005). Targeting beneficiaries for social protection intervention is crucial since missing them may influence the objective of the intended program. At the end of the day, the poor continue to be poor whiles the haves continue to benefit from what was intended to cushion the vulnerable.

Targeting the poor is the most important means in reducing poverty and building resilience but this is often challenged thereby denying the poor or the marginalized the opportunity to benefit from the intervention. The effectiveness of interventions may be influenced by the extent to which the intervention reached the targeted individual or groups and may also have a direct relationship to the type of targeting method that was employed. There are different methods of targeting mechanism which include, categorical and geographic targeting, self-selection and individual assessment.

Domelen (2007) noted that "there is no 'one size fits all' targeting strategy" and argued that the appropriate targeting mechanism should be linked to the objectives of the intervention (Domelen, 2007). He stressed that the targeting should reflect the local context, including framework of the various institutions, readily information, achieve certain degree of inequality, governance characteristics, and the demographic profile, taking into consideration minority groups (Domelen, 2007). The purpose of targeting is to improve effectiveness and ensure that social interventions benefit the deserving poor and vulnerable groups (Domelen, 2007; Stephen Devereux and Ana Solórzano, 2016).

The USAID FTF program involved the Metropolitan, Municipal and District Assemblies in targeting deserving communities, individuals and households in the FTF ZOI (METSS-Ghana, 2012; Zereyesus et al., 2014). Communities and households were the level at which

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the target was done. The selection was done by the MMDAs under which the communities and households belong. Though this may have its own pros and cons, it was mainly aimed at reaching the deserving poor communities and households (METSS-Ghana, 2012).

2.8 Impact evaluation approaches

Program evaluation refers to as a " set of interventions, marshalled to attain specific global, regional, country, or sector development objectives" (OECD-DAC, 2010). On the other hand, project evaluation refers to "an individual development intervention designed to achieve specific objectives within specified resources and implementation schedules, often within the framework of a broader program."(OECD-DAC, 2010). Evaluation of project or programs may have two main dimensions. The first-dimension main look at the operational aspect of the project or program, and examine how effectively project or programs are implemented. This is referred to as operational evaluation, this evaluation focuses on whether challenges between planned and realised outcomes of the project or program. The second dimension looks at the impact of the program on the beneficiaries (Shahidur et al, 2010). This evaluation process examines whether differences in well-being are indeed attributable to the project or program in question (Shahidur et al, 2010). There is a need for the application of a statistical methodology in the evaluation of the project or program to estimate the impact of the intervention. Project or program evaluation could be conducted before an intervention is rolled up to predict project or program impacts using data available before the intervention. The above process is termed as ex-ante evaluation whilst ex-post evaluation studies outcomes after the implementation of a said project or program (METSS-Ghana, 2012; OECD-DAC, 2010; Shahidur et al, 2010).

Impact evaluation assess the effect that can be attributed to a particular program or a development intervention, such as a government project or policy (Shahidur et al, 2010).

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The utmost important aspect of an impact evaluation is its capacity to estimate or determine the effect that is exclusively attributable to the program. An evaluation may be able to identify and attribute other impacts that would have occurred even in the absence of the program apart from the core mandate of comparing the situation of beneficiaries before and after a given program (Gertler et al, 2016; Shahidur et al, 2010). The cardinal prerequisite for impact evaluation is to support policy makers or program managers to make decisions to ensure that programs are generating intended results. Furthermore, it is to promote accountability in the allocation and disbursement of resources across implementation levels to accelerate desired program outcomes (Shahidur et al, 2010). Another central feature of an impact evaluation is to fill the gaps in understanding what really works and what does not, and how the observed change could be attributed to the particular policy or intervention (IEG/World Bank/IFC/MIGA, 2010; Shahidur et al, 2010). Hypothetically, an impact evaluation describes the difference between the condition of the beneficiaries after the program has ended. In other words, what would have been their situation in the absence of the program (Gertler et al, 2016; Shahidur et al, 2010). In order to perform an impact evaluation, there is the need to have a comparison group, this group should be fairly similar to those that would benefit from the program directly. This is referred to as the counterfactual (Shahidur et al, 2010), defining what would have been the real situation of beneficiaries in case there was no program at all. This bring to bear the major challenge that confronts impact evaluation since it is difficult to have a similar group that could represent same characteristics of the people who were offered the program (Alderman et al., 2009; Lima & Figueiredo, n.d.; Shahidur et al, 2010).

Several approaches can be used to estimating the effect of an intervention, policy or program. Examples of impact evaluation methods includes; Difference in difference (DID), Instrumental variables (IV), Propensity score matching (PSM), Mixed methods-quantitative

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and qualitative, and, Regression discontinuity (RD). (Shahidur R. Khandker, Gayatri B. Koolwal, 2010). Information on the other impact evaluation methods are have been detailed by (Bedi et al., 2006; Eliza & Anyangwe, 2013; Health Cornell, 2019; Lima & Figueiredo, n.d.; Gertler et al., 2016; Shahidur R. Khandker, Gayatri B. Koolwal, 2010; White & Raitzer, n.d.). This review of literature focuses on the DID method for estimating the impact of the feed-the-future program.

2.9 Difference-in-difference method

This evaluation employs the DID estimator to estimate the impact of the FTF program on the reduction of malnutrition. DID is a quasi-experimental design which provides an opportunity to statistically estimate the effect of a project or program or taking into accounts other possible unobserved characteristics that may affect the true effect of the intervention (Bharadwaj, 2010; Grieve, Noe, Sutton, & Sekhon, 2016).

DID compares the before-and-after difference for the group receiving the intervention (where participants were not randomly assigned) to the before-after difference for those who did not. The changes in products between a population that benefited from a given program (treatment group) and a population that was denied the same program (the comparison group) over time is compared to other to estimate the real effect (Anders Fredriksson, 2019; Bharadwaj, 2010; Fredriksson & Oliveira, 2019; Yamamoto, 2016). To produce a beeter estimate of the counterfeit counterfactual, the difference-in-differences approach thus combines the two counterfactuals. It estimates the before-and-after comparisons and comparisons between those who enjoyed the participate and those who did not enjoy the program even though they were part of those earmarked to enjoy the program (Alderman et al., 2009;Fredriksson & Oliveira, 2019; OECD-DAC, 2010; Shahidur R. Khandker, Gayatri B. Koolwal, 2010). DID works better if there is a “short” time interval between baseline and

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follow-up, but, how "short" to still measure impact? It depends on the product and selection of comparison group (Bharadwaj, 2010; Fredriksson & Oliveira, 2019; Grieve et al., 2016).

The impact estimate of the program using difference-in-differences method is computed as follows:

a) In the first stage, the difference in the product *(Y)* between the before and after situations for the treatment group *(B − A)* is calculated.

b) Secondly, the difference in the product *(Y)* between the before and after situations for the comparison group *(D − C)* is also calculated.

c) In the final stage, the difference between the difference in products for the treatment group *(B − A)* and the difference for the comparison group $(D - C)$, or

$DID = (B - A) - (D - C)$ is then calculated. This "difference-in-differences" is the real impact of the program estimated either at midline or end line of the said program. A positive DID estimate suggest an increase whilst a negative estimate suggest a reduction depending on the objective of the program or policy in question (Shahidur R. Khandker, Gayatri B. Koolwal, 2010; Yamamoto, 2016).

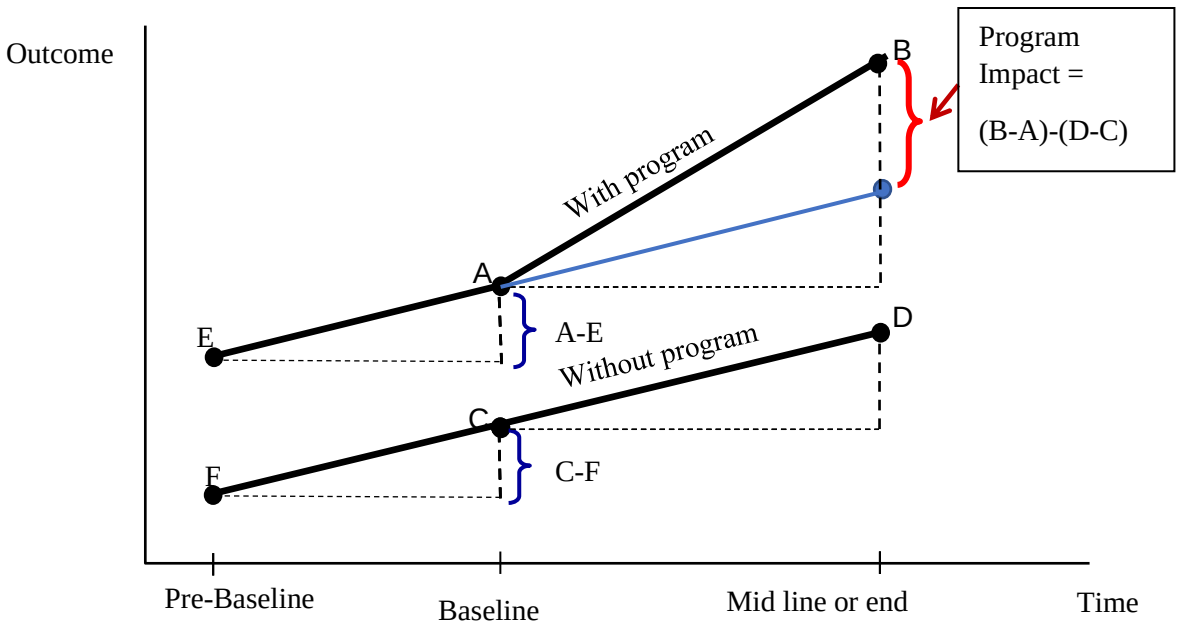

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Figure 2 Graphical presentation of difference-in-difference estimator

A key condition underlying DID analysis is the parallel trend assumption. Hypothetically, the treated group would have had the same change as the comparison group in if the program has not existed (Anders Fredriksson, 2019; Fredriksson & Oliveira, 2019; Grieve et al., 2016; Shahidur R. Khandker, Gayatri B. Koolwal, 2010). Ideally, there should be a pre-baseline data for the population understudy but the challenge is that such data is rarely available. The parallel trend assumption would be perfect if (A-E)=(C-F) as shown in Figure 2. Parallel trend is satisfied if there is time-invariant and additive unobserved confounding. On the other hand, the assumption is violated if there is unobserved time-varying confounding (Shahidur R. Khandker, Gayatri B. Koolwal, 2010; Yamamoto, 2016). The parallel trend assumption works better if the program was randomly allocated between the program group and the comparison group (Fredriksson & Oliveira, 2019). Observed and unobserved characteristics of the two groups will be similar to allow for a robust estimate. A part from ensuring that the parallel trend assumption holds to enable evaluators to have robust estimates, application of matching procedures could be employed to control for variables (Fredriksson & Oliveira, 2019). Observation from the treated and comparison group could be matched to produce robust DID estimate. Each observation from the treatment group is matched to a specific or several control observations. This is done to produce an average over the treatment observations using methods such as n-nearest neighbour matching, Mahalanobis matching etc (Fredriksson & Oliveira, 2019). The matching procedures could be applied before the start of the intervention and could be matched on community-characteristics.

DID is one of the most regularly used impact evaluation methods (Fredriksson & Oliveira, 2019), which is based on a blend of before-after and treatment-control group assessments.

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DID as a method has an intuitive application and has been extensively used in economics, health research, research in public policy, management and related discipline (Attanasio, Edepo, & Mesnard, 2005; Bharadwaj, 2010; Brantly et al, 2018; Powell-Jackson, n.d.). Brantly et al (2018) have observed that the DID has become one of the most popular evaluation techniques designed to evaluate causal relationship of policy or program interventions (Brantly Callaway and Pedro H. C. Sant'Anna, 2018). There is the treated group and the control which serves as the counterfactual (the control group; the clone for the treated group). The analysis involves having two groups with varying two or more time periods: in the first time point, no one is given the treatment, and at the second time point, some individuals are offered the program (the treated group), and some individuals are deliberately denied the program (the control group) (Fredriksson & Oliveira, 2019; Grieve et al., 2016).

The most variable of interest is time, at what time point are we looking at and the probable change in the program given post-intervention period where none of the groups had no intervention. The axiom is that, if the intervention is absent, the average consequences for those who enjoyed the program and those who did not (control groups) would have followed parallel trends over time (Albouy, 1994; Brantly et al, 2018; Handa & Park, 2014). Per the parallel trends assumption, we can determine the average treatment effect for those who enjoyed the program (ATT) by comparing the average change in outcomes experienced by those who enjoyed the program to the average difference in outcomes experienced by those who were denied the program (Brantly et al., 2018; Lechner, 2011). The means difference within groups and between groups can be estimated to establish the real effect of the intervention.

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DID approach is an evaluation research design for estimating the cause and effect of a given intervention and based on the comparison of the program at a different time point (Anders Fredriksson, 2019; Bharadwaj, 2010). The DID is a popular economic tool for estimating differences in economic activities with respect to time. DID has been used in many instances in the estimation of cause and effect of programs or intervention by predicting the level at which the change or impact of the given intervention could be attributed to the program (Brantly et al., 2018).

In India, an impact evaluation was done to evaluate the impact of an "integrated nutrition and health program on neonatal mortality in rural northern India" using the DID technique to compare baseline and end line effect of the program in the area (Baqui et al., 2008). In SSA, an impact evaluation study was conducted on government-run unconditional social cash transfer programs, and the evaluation results showed that the programs had significant positive effect on the livelihoods of the households who benefitted from the program using the DID approach (Food and Agriculture Organization of the United Nations, 2018). In all, seven countries were involved in the "household and individual-level economic impacts of cash transfer programs in sub-Saharan Africa" namely: Ghana, Lesotho, Zambia, Ethiopia, Kenya, Zimbabwe, and Malawi. The Evaluators of the program used the DID technique to estimate the average treatment effect of the cash transfer programs of the benefiting countries (Food and Agriculture Organization of the United Nations, 2018).

In Ghana, Hand and Park (2014) used DID to estimate the impact of "the Livelihood Empowerment Against Poverty (LEAP) Program of the Ministry of Gender, Children and Social Protection (MoGCSP)", which is a Government of Ghana's (GoG) social cash transfer intervention (Ministry of Gender Children and Social Protection, 2015). The

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program offered cash and health insurance to households across Ghana who very poor (Handa & Park, 2014). The implication of the results was that: one, there was a low value of the LEAP transfer which according to the report saw a partial improvement from January 2012, two, was the intermittent payment cycles affecting households to have their continuing consumption. The third issue was that, there were no clear outcome of a strong improvement in NHIS coverage among LEAP beneficiary households and there was no improvement on health services utilization or a reduction in the out-of-pocket health expenditure by beneficiary households. This revealed weaknesses in trying to link LEAP beneficiaries to health services utilization which necessitate additional inquiry (Handa & Park, 2014).

The DID estimator provides the opportunity to control for confounding factors that may affect the program, such as the presence of a similar intervention within the catchment area. Controlling for the unobserved characteristics help in estimating the real impact of the intervention using instrumental variables (Bedi et al., 2006). The DID approach in estimating cause and effect could be applied in the interim impact evaluation of the FTF - program since the method presents a robust estimate of effect. Using the DID for this evaluation work, the effects for the treated, the non-treated (counterfactual), and the population at large would be considered separately.

In summary, malnutrition is a major problem affecting mainly children under-five years old in most developing countries (UNICEF/WHO/World Bank, 2018). To be able to fight against it, conscious efforts should be made by creating the environment for government and private sector involvement (World Bank Group, 2018). From the literature review, malnutrition has a adverse effect on the cognitive development of children which may or affects them in their entire life (GSS, 2016). Given the above, development agencies,

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governments and individuals should work together and understand the contextual issues underpinning this challenge. The need to eradicate malnutrition is now, and needs all hands-on deck (World Bank Group, 2018).

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CHAPTER THREE

METHODS

3.1 Study design

Secondary data from the USAID METSS FTF population-based survey 2012 and 2015 was used for the analysis. This is the baseline and midline surveys that were conducted in 2012 and 2015 respectively in the three Northern regions and the northern part of Bono Ahafo region (now separated into Ahafo, Bono and Bono East regions). The baseline survey was done to provide baseline data to measure the FTF indicators for malnutrition in the FTF ZOI. In all, the survey collected information on eleven modules to capture the requisite information necessary for the baseline and midline indicators. For the purposes of this evaluation, data on children anthropometry measurements, children minimum acceptable diet and households' characteristics was used to estimate the impact of the program on malnutrition in children.

3.2 Study area

The study was done in the three Northern regions and the northern part of Brong-Ahafo forming the Savannah ecological zone of Ghana. In all, there were forty-five districts constituting the RING enumeration areas and the Non-RING enumeration areas. Seven districts from the Brong-Ahafo (five of them are now in Bono East and the remaining two are found in Bono region), 9 from the Upper East region, another 9 from Upper West region and lastly 20 districts from the Northern region (Now Northern, North East and Savanah regions) constituted the study area (METSS-Ghana, 2012; Zereyesus et al., 2014). The study will keep to the original regions as used in the data collection.

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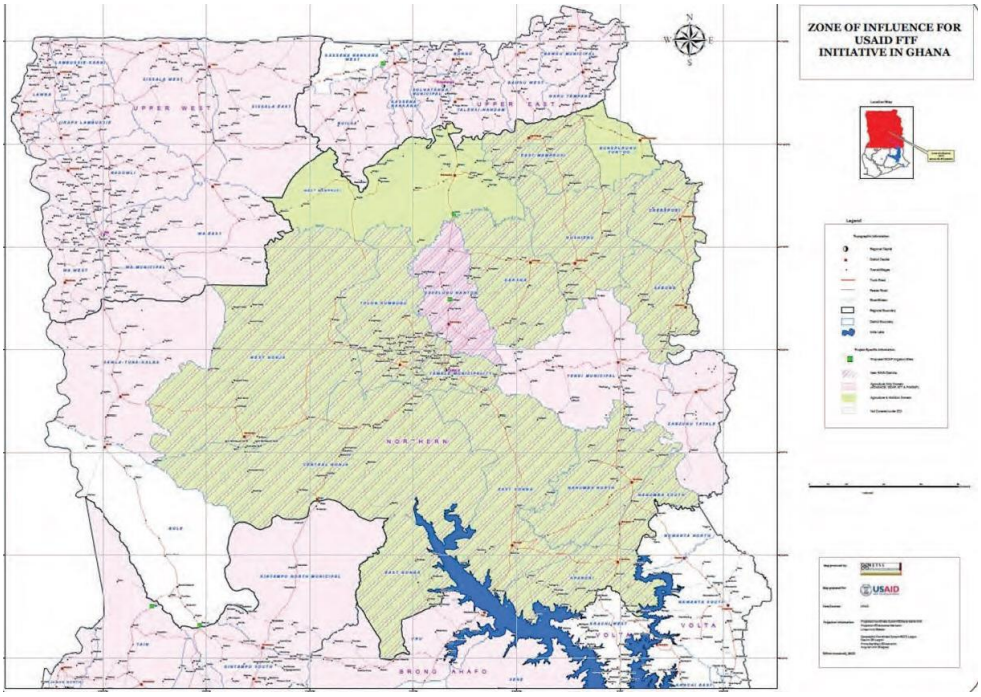

Figure 3: Map of the FTF ZOI
Source: METSS, Ghana, 2012 as cited in Baseline FTF Indicator for Northern Ghana, (Zereyesus et al, 2014)

3.3 Study population

The study population for the FTF program- were women of reproductive age (WRA) and children under-five years old in the ZOI. For the purposes of this evaluation, the study population is all children under five in the FTF ZOI whose mothers/caretakers/households were met and interviewed in the FTF Population Baseline Survey (METSS-Ghana, 2012). At midline, participants were sample from the baseline population.

3.4 Inclusion/exclusion criteria

The study included all children who were met and their anthropometry measurements were taken during the data collection period. Children without anthropometry measurements were excluded from the analysis. Children who had inaccurate measurements (above the WHO cut off point for measuring children's anthropometry) were also excluded from the analysis.

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3.5 Study variables

The variables of interest for this evaluation activity were grouped into two main categories; household demographic indicators, and child characteristics. Mother or caregiver characteristics were excluded due to incomplete data for those indicators.

3.5.1 Dependent Variable

Three dependent variables were studied in other to answer the effect on malnutrition namely; underweight, stunting, and wasting. The definition of the dependent variables is shown in Table 4.

3.5.2 Independent Variables

Household characteristics and child characteristics: Table 2 show the list of the selected household and child characteristic.

Table 1: Study variable of interest for the evaluation

Household demographics	**Child characteristics**
Strata-study arm	Strata-study arm
Region	Sex of child
Sex of household head	Age of child
Religion	Anthropometry for children
Gendered household type	The acceptable minimum diet of Children
The educational level of the household head	Breastfeeding: Exclusive breastfeeding
Marital status of the household head	Individual dietary diversity Score for Children 6-59 months
Household hunger scale	
Household wealth quintile (Household self-evaluation of poverty status was used)	
Household composition	
Ethnicity	
Type of locality	

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3.6 Definition of indicators

The FTF program had eleven baseline indicators which they were interested in measuring. For this evaluation exercise, 3 out of the 11 FTF indicators were considered. The indicators of interest for this study were stunting, wasting, and underweight (METSS-Ghana, 2012; Zereyesus et al., 2014). Table 3, defines the 3 three indicators and also describes numerator and denominator for the measurement of the indicators. Table 4 also provides the objectives of the evaluation exercise and the expected outcome giving further details of how these objectives were measured as well as the statistical models to be used.

Table 2: Definition of indicators

Indicator Name	Definition		
	Numerator	Denominator	Definition
Stunting	Number of children under-five who fall below -2 standard deviations from the median ***height-for-age*** of the reference* population	Children under five years of age in the surveyed population	Stunting refers to a child who is too short for his or her age.
Wasting	Number of children under-five who fall below -2 standard deviations from the median ***weight-for-height*** of the reference* population	Children under five years of age in the surveyed population	All children in the ZOI are too thin for his or her height.
Underweight	Number of children under-five who fall below -2 standard deviations from the median ***weight-for-height*** of the reference* population	Children under five years of age in the surveyed population	All children in the ZOI who are too light for his or her height.

*The reference population is based on the WHO Child Growth Standards, 2006. Underweight was used in this evaluation instead of the Overweight used originally.

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Table 3: Objectives and outcome measurement

Objectives	Outcome	Data source	Measure	How to measure
To estimate the prevalence of underweight, stunting, and wasting in the ZOI	Prevalence of underweight, stunted, and wasted children in the ZOI	METSS Ghana Feed the Future PBS Baseline (2012) and Midline (2015) data	The proportion of children under five who were underweight, stunted, and wasted at baseline and midline	Compare the proportion of children under five who were underweight, stunted, and wasted at baseline to the midline
To determine factors independently associated with malnutrition among children under five years in the ZOI	Establish independent factors that were associated with underweight, stunting, and wasting in the ZOI.	METSS Ghana Feed the Future PBS Baseline (2012) and Midline (2015) data	Factors independently associated with underweight, stunting, and wasting in the ZOI (Household/child characteristics)	Univariate and multivariate logistic regression of the outcome variables and household/child factors
To estimate the impact of the FTF program on underweight, stunting, and wasting among children under five years in the ZOI	Reduction in the prevalence of underweight, stunting, and wasting attributable to the FTF program in the ZOI	METSS Ghana Feed the Future PBS Baseline (2012) and Midterm (2015) data	Differences in the prevalence of underweight, stunting, and wasted children u-5 in the ZOI comparing baseline and midline	The difference-in-difference estimator. (Crude and adjusted estimates)

3.7 Sampling

3.7.1 Sample size determination

According to the 2012 FTF Ghana population-based survey report, a cluster sample was randomly selected from the ZOI by METSS, from which households were randomly sampled for the survey (sample size of 4580 was considered; due to likelihood of non-response rate of 10 percent, the figure was rounded up to 4600. It was to give further cushion and, or to further boost the power if the sample size is attained). This sample size was assigned to the two strata ("agriculture-nutrition intervention area – Strata I" and

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"agriculture only intervention area – Strata II") in the ZOI (METSS-Ghana, 2012; Zereyesus et al., 2014). The sample size was calculated on three main indicators of the FTF program namely; poverty, underweight, and stunting. The three indicators were defined by i = 1, 2, 3 – poverty, stunting, and underweight.

The sample size was calculated based on the following assumptions;

1. The baseline prevalence rate of poverty (*p11*) for the ZOI estimated from the GLSSV was 0.567. It is assumed that this rate is would decline by 1.0 percent per year between 2012 and 2017, giving an estimated ending prevalence rate of poverty (*p21*) of 0.517.

2. The initial prevalence rate of stunting for children younger than 60 months (*p12*) was 0.322. This rate was assumed to decline annually by 1.32 percent, and ending prevalence rate (*p22*) is estimated at 0.256.

3. The initial prevalence of underweight children less than 60 months (*p13*) was 0.219 and the ending rate (*p23*) is estimated at 0.176 under an assumption of 1.32 percent decline per annum over five years.

4. Type I error (α) is assumed at 5 percent.

5. Type II error (β) is assumed at 20 percent.

Equation (1) was used to estimate the sample size for each of the indicators based on the set assumptions *ni*:

$$n_i=\{[\frac{(p1iq1i)+(p2iq2i)}{(p2i-p1i)2}]x(z_{1-\alpha}+z_{1-\beta})^2\}=Deff_i \quad (1)$$

where *qli* is 1-*pli* and *q2i* is 1-*p2i* and Z1-α and Z1-β measure the standard Z-scores at the 95 percent and 80 percent levels respectively. $Deff_i$ is the design effect for the sampling design for the indicator *i*. It is estimated at 3.40, 1.21, and 1.25 for the prevalence of poverty, stunting, and underweight, respectively. (Zereyesus et al., 2014).

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3.7.2 Sampling procedure

A two-stage probability sampling approach was employed in drawing the survey sample. In the first stage, Enumeration areas (EA) were first selected from the 2010 Ghana census data using the probability proportional to size method. In the second stage, household heads were sampled systematically from each sampled EA (METSS-Ghana, 2012; Zereyesus et al., 2014). Twenty households were further sampled from each EA drawn from a total of 230 EAs which was produced by the Ghana Statistical Service (GSS). After this, ISSER sampled a list of households and household head bio-data to sample the second level of the household sample (METSS-Ghana, 2012; Zereyesus et al., 2014).

3.8 Data collection techniques

According to the FTF Ghana population-based survey report 2012, data was collected by face to face interviews, administered to each household using electronic data capture device. The questionnaire was uploaded on the electronic device, the study team also provided paper versions of the instruments to be used in instances where the electronic device may not function. The questionnaire was organized into two-time points (Visit 1 and Visit 2). Visit I was made up of 10 thematic sections which included Module I: Household Identification Data, while Visit 2 was made up of Module II: Household Consumption Expenditure (METSS-Ghana, 2012; Zereyesus et al., 2014).

3.9 Quality control

To ensure data quality, according to the FTF Ghana population-based report 2012, the PBS employed two-pronged quality control and assurance strategies. First, logical strings and conditional clauses were built into the programmed PBS software which ensured that appropriate responses were captured and rejected responses that were not accurate.

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Secondly, they created discussions platform across teams, which focused on issues that emerged from the field. METSS and ISSER senior staff also conducted unscheduled checks of enumerators and field supervisors to ensure that data were being properly collected, recorded, and stored. Enumeration data were transferred to servers at METSS and KSU as backup procedures and provided the opportunity where outliers and systematic errors were identified and resolved. As an additional check, field supervisors checked a minimum of 10.0 percent of all interviews conducted by the enumerators. Queries that were raised from this check were sent back to the field for completeness and onward submission to METSS and KSU (METSS-Ghana, 2012; Zereyesus et al., 2014).

3.10 Data process and analysis

Data analysis was divided into three main parts. The first part was the descriptive analysis of the household, and child characteristics. The second was the univariate and multivariate analysis of factors that independently associated with the outcome variables at baseline and midline. The third aspect was the application of the DID technique to estimate the impact or effect of the FTF program on reducing underweight, stunting, and wasting in the ZOI. Both crude and adjusted estimates DID results were computed.

3.11 Data analysis

The data used for this study was obtained from the USAID METSS Ghana office. Both baseline and midline datasets were obtained and used for the analysis. In all, eleven datasets were obtained containing the different modules of the FTF initiatives. The data was stored in Stata format and was imported into Stata version 15.0 for cleaning and analysis (Stata-Corp, College Station, TX). The ‘Anthropometry for children’ data was considered as the master data for this study upon which other datasets were merged. Out of the eleven data

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sets, this study used ten considering the variables of interest (Access to credit data was not considered because it did not contain the variables of interest for the analysis). After merging the datasets separately for both timelines, the baseline data was appended to the midline data. The baseline data contained 3,361 observations, whiles the midline contained 2,905 observations. Children with anthropometry measurements below or above the WHO recommended cut off points were not included in the analysis. Children who were exactly 60 months were also excluded from the analysis.

Variables such as locality, age and sex of household head, education level of household head, ethnicity, religion, marital status of household head, household size, gendered household type, household self-evaluation of poverty, and household hunger scale, age, and sex of child were used as household and child characteristics for the analysis (Table 2). After cleaning the data, the baseline data contained a combined sample size of 1,947 and 1,414 for the intervention and control groups respectively making a total of 3361. The midline data also contained a sample size of 1,589 and 1,311 for the intervention and control groups respectively which were also combined making a total of 2900.

Dummy variables were created for length/height-for-age (Underweight), weight-for-height (stunting), and weight-for-age (wasting) for children 0 to 49 months of age using WHO child growth standards (Leroy, 2011). After the above exercise, the estimates were classified into a binary outcome; underweight or not-underweight, stunted or not-stunted and, wasted or not wasted. The prevalence of underweight, stunting, and wasting in the ZOI were then computed for both time points. The binary classification of the outcome variables was used throughout the various levels of the data analysis.

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Also, dummies for minimum acceptable diet (MAD) of children 6 to 23 months, Individual Dietary Diversity Scores for children 6 to 59 months (IDDS), and household hunger score were computed for each child and household respectively (Ballard, Deitchler, & Ballard, 2011; Bilinsky & Swindale, 2006; "Indicators for assessing infant and young child feeding practices," 2010). Although dummies for the minimum acceptable diet for children, and individual dietary diversity score for children (6-59 months) were generated, they were excluded from the analysis due to the problem of collinearity.

The study depended on a self-evaluation of household poverty status which was reported by respondents during the survey as a proxy for the wealth quintiles (Respondents were asked to self-evaluate their poverty levels, whether they see themselves as being very poor, poor, neither poor nor rich, rich and, very rich). The self-evaluated poverty status data were collected at midline hence it was not included in the background characteristics of the household. It was considered at the midline as part of the household factors used for the univariate and multivariate analysis at the midline.

Descriptive statistics of the selected household and child characteristics were described using percentages. A univariate logistic regression model was considered for each of the predictor variables, to ascertain if they were independently associated with underweight, stunting and, wasting at baseline and midline. All the predictor variables that showed statistical significance at the univariate level were included in a multiple logistic regression model at a significance level of 5 percent.

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3.12 Difference-in-difference analysis

The DID estimation technique was employed to establish the effect of the FTF program on the outcome variable at a 95 percent confidence level (Brantly Callaway and Pedro H. C. Sant'Anna, 2018; Lechner, 2011; Torres-Reyna, 2010). The random-effect model was employed to cater for time-invariant variables, and also, to control for the differences across entities that may have some influence on the dependent variable (Torres-Reyna, 2010). To satisfy the parallel trend assumption (characteristics within the two groups should be similar). The DID formulae postulate that the causal effect or impact (Δ) of a program or an outcome (Y) is the difference that exists between the outcome (Y) with the intervention. Thus, with the program, P=1 and without the program P=0.

$$\Delta = (Y \mid P = 1) - (Y \mid P = 0). \quad (1)$$

Based on this, a regression model was fitted to estimate the effect of the program. The DID regression analysis was modeled in the following;

$$Yi = \alpha + \beta Ti + \gamma ti + \delta\,(Ti \cdot ti) + \varepsilon i \quad (2)$$

where the coefficients α, β, γ, δ, are all unknown parameters and εi is a random, unobserved "error" term which contains all determinants of Yi. The coefficients have the following interpretation;

α = constant term

β = treatment group-specific effect (to account for average permanent differences between treatment and control)

γ = time trend common to control and treatment groups (time 1 and 2)

δ = true effect of treatment

(Gertler et al, 2016; Wooldridge, 2007).

The DID was computed using the Stata embedded DID package(Villa J.M, 2016.).

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3.13 Ethical Considerations

According to the 2012 METSS Ghana population-based survey report, Ethical approval for the FTF PBS was sought from the Ethical Review Committee of the University of Cape Coast. Copies of the informed consent forms were given to all respondent households who participated in the PBS after the information in the informed consent was read to them. Additionally, all respondents' households consented before the height of women and child anthropometry data were taken or measured (METSS-Ghana, 2012).

For this evaluation exercise, permission was sought from the USAID METSS Ghana office to use the Feed the Future PBS baseline and interim data for the evaluation work. Approval for the use of the data was granted by the METSS USAID office in Accra.

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CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristics of household

Table 5 shows selected household head and child background characteristics of the FTF ZOI who participated in the baseline and midline surveys in 2012 and 2015. At baseline, a total of 3361 households with children under five years old were reached and interviewed whiles a sample of 2905 children were included in the midline survey. Both baseline and midline surveys were conducted in the Brong-Ahafo, Northern, Upper East, and Upper West regions of Ghana. The majority of the surveyed households were from the Northern region (70.4%), while 9 percent, 12.6 percent, and 8 percent of the participating households were from the Brong-Ahafo, Upper East, and Upper West regions respectively.

Of the 3,361 households that participated in the baseline survey, 82 percent of them were urban residents while the remaining 18 percent of households resided in rural localities. 57.9 percent of the sampled household received the FTF program whilst 42.1 percent did not receive the intervention thereby constituting the counterfactual. Household heads were mainly males accounting for 87 percent whilst female household heads constituted the remaining.

The age distribution of household members was grouped into six categories (< 15 years, 15 – 30 years, 31 – 45 years, 46 – 60 years, 61 – 75 years, and 76+ years). The majority of household members were in the <15 years forming 46 percent of the total age distribution of household members. The second-largest category was the 15-30 years (37.3 %). The rest of the categories together were 16.7 percent

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Also, the age of children 0 to 5 was grouped into five categories (< 12 months, 12 – 23 months, 24 – 35 months, 36 – 47 months, and 48 – 59 months). The majority of the children were aged between 36 – 47 months (24.6%). The 24 – 35 months' age group had the lowest percentage of children (16.0%). The distribution for the other age groups is presented in Table 5.

The majority of household heads had no formal education constituting about 94.3 percent of the total sampled household. Of the remaining households, 4.1 percent and 1.7 percent had basic and secondary level education respectively. The predominant ethnic group was Mole-Dagbani (48.5%). Other ethnic groups were Gurma / Grushi / Mande (34.3%), Ga-Dangme/Ewe/Guan (9.9%), and Akan (4.3%) constituted the lowest ethnicity in the sampled household.

More than half of the household heads were married (32.8%), while 55.3 percent were never married or were single. The remaining were either divorced, widowed, separated, or were cohabiting. About 8.7 percent of the data on the marital status of the household was missed. The predominant religion was Islam, about 47.2 percent of the participating households followed by Christianity (29.8%). Traditional religion constituted 21.1 percent, and a little below 2 percent (1.6%) did not belong to any religion.

In gendered household type, 95 percent of the households were headed by a male and female adult. A little below 5 percent were headed by an adult female only whilst less than 1 percent (0.6%) were headed by an adult male-only. Household size was grouped into three categories (1 to 5, 6 to 10, and above 10). The majority of households (48%) had 6 to 10 members, whereas 19 percent of the households had more than 10 members. With regards to the hunger index, 82.5 percent, 6.8 percent, and 0.7 percent of the households had no or little, moderate and severe hunger respectively.

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Table 4: Background characteristics of household

Variables	Frequency (N=3,361)	Percent
Region		
Brong Ahafo	301	9.0
Northern	2,367	70.4
Upper East	423	12.6
Upper West	270	8.0
Type of locality		
Rural	2,757	82.0
Urban	604	18.0
Program		
Control	1,414	42.1
Treated	1,947	57.9
Sex of household head		
Male	2,925	87.0
Female	436	13.0
Age distribution of household members		
< 15 years	1,546	46.0
15 – 30 years	1,252	37.3
31 – 45 years	133	4.0
46 – 60 years	266	7.9
61 – 75 years	110	3.3
76+ years	54	1.6
Educational level of household head		
None	3,169	94.3
Basic	136	4.1
Secondary	56	1.7
Ethnicity		
Akan	145	4.3
Ga-Dangme/Ewe/Guan	334	9.9
Mole-Dagbani	1,629	48.5
Gurma/Grushi/Mande	1,154	34.3
Other	99	2.9
Religion		
No religion	53	1.6
Christianity	998	29.8
Islam	1,590	47.3
Traditional	708	21.1
Other	12	0.4
Gendered household type		
Adult male, no adult female	21	0.6
Adult female, no adult male	150	4.5
Male and Female adults	3,190	94.9
Household size		
1 to 5 people	1,116	33.0
6 to 10 people	1,598	48.0
11 above	647	19.0

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Hunger Scale of household		
No or little hunger	2,773	82.5
Moderate hunger in HH	565	16.8
Severe hunger	23	0.7
Age category of Children 0 to 5 years		
< 12 months	686	20.4
12 – 23 months	599	17.8
24 – 35 months	539	16.0
36 – 47 months	827	24.6
48 – 59 months	710	21.1
Marital status		
Never Married/single	1,860	55.3
Living together	4	0.1
Married	1,102	32.8
Separated/Divorced	31	1.0
Widowed	71	2.1
*Missing data	293	8.7

4.2 Prevalence of Underweight, Stunting and Wasting at Baseline and Midline

4.2.1 Underweight

Figure 3 shows the baseline and midline prevalence of underweight among children in the ZOI. The prevalence of underweight at baseline was 17.9 percent versus 19.8 percent in the control group and the treated group respectively. The prevalence of underweight was 19.1 percent versus 20.6 percent at the midline in the control and treated group respectively. At both baseline and midline, the prevalence of underweight seems to be higher in the treated group compared to the control group.

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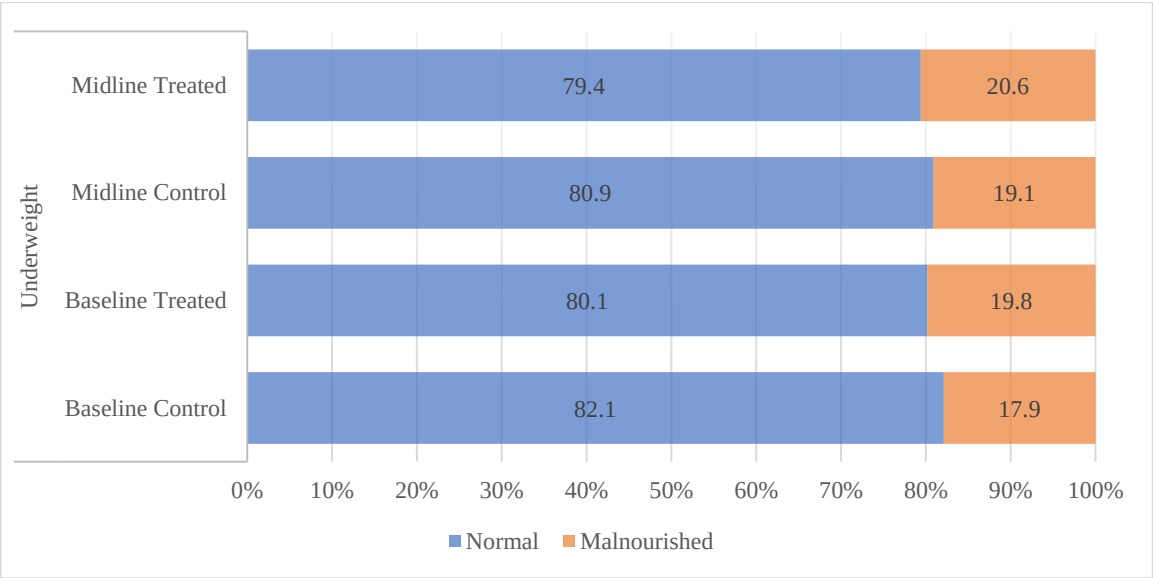

Figure 4: Prevalence of underweight at baseline and midline

4.2.2 Stunting

Figure 4 shows the baseline and midline prevalence of stunted children in the ZOI. At baseline, the prevalence of stunting was 33.8 percent versus 38.3 percent in the control and treated group respectively. The prevalence of stunting was 40.3 percent versus 44.7 percent at the midline in the control and treated group respectively.

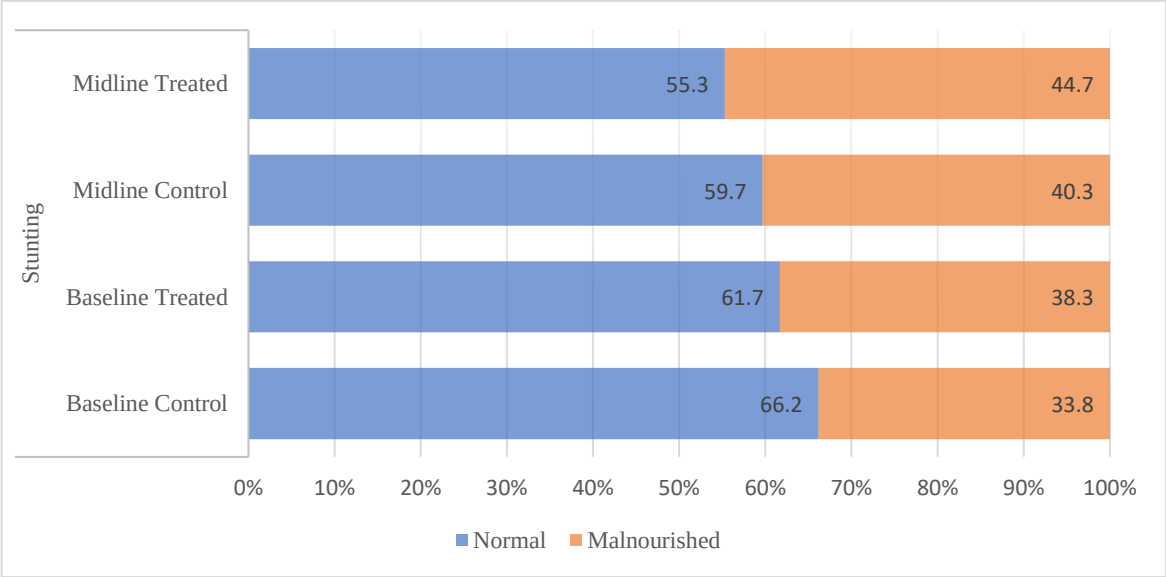

Figure 5: Prevalence of stunting at baseline and midline

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4.2.3 Wasting

Figure 5 shows the baseline and midline prevalence of wasting. The baseline prevalence of wasting was 10 percent versus 12.2 percent in the control and the treated group respectively. The prevalence of wasting was 7.2 percent versus 9.8 percent at the midline in the control and treated group respectively. The prevalence within the two groups reduced from the baseline estimates.

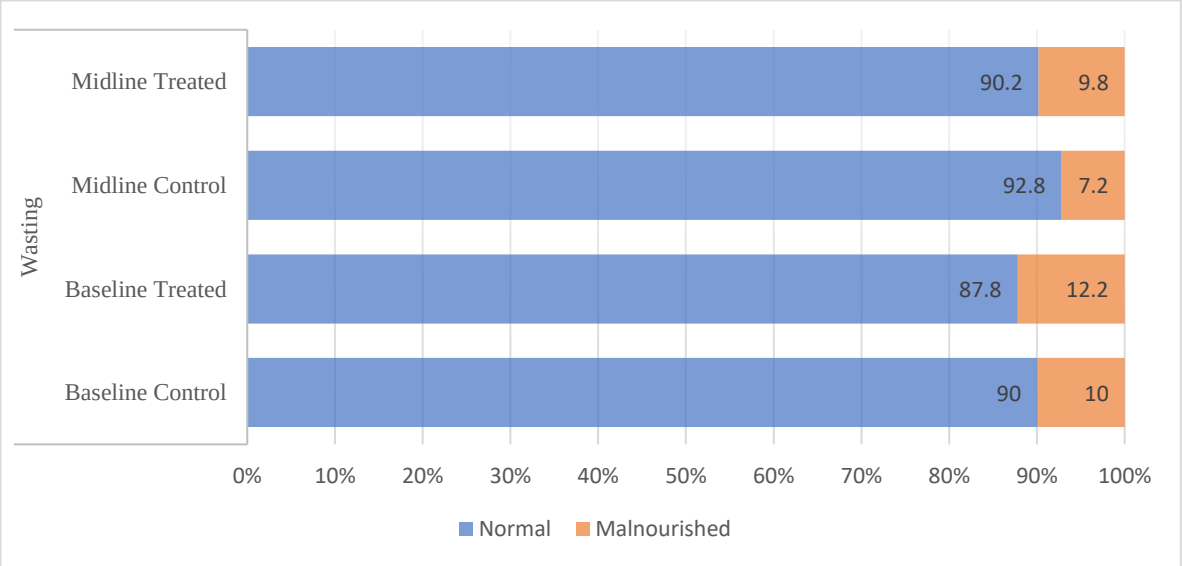

Figure 6: Prevalence of wasting baseline and midline

4.3 Factors independently associated with underweight at baseline

At baseline, from the unadjusted analysis for underweight, it was found that the FTF program age of children and ethnicity was significantly associated with underweight as shown in Table 6. Regarding the age of the children, those who were 12 months old and above had a significantly higher odds of being underweight compared to those less than 12 months of age. For example, compared to the reference category of less than 12 months, the odds of being underweight for children between the ages of 12 – 23 months and 24 – 35 months was more than double (OR: 2.05 and 2.12 for those 12 – 23 months and 24 – 35 months respectively). For those between the ages of 36 – 47 months, the odds of being underweight is 68 percent higher compared to the children in the reference age of less

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than 12 months (OR 1.68, 95% CI 1.25 to 2.24). For Ethnicity, children from the Mole-Dagbani ethnic group had a significantly higher odds of being underweight compared to children from the Akan ethnic group (OR 1.68, 95% CI 1.01 to 2.80).

Table 5: Factors independently associated with underweight at baseline

Predictors of underweight	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	0.74	0.37 – 1.47	0.388
Islam	0.86	0.44 – 1.70	0.669
Traditional	0.79	0.40 – 1.60	0.517
Other	0.31	0.04 – 2.71	0.292
Educational level of HH			
No education	1		
Basic	1.36	0.90 – 2.04	0.143
Secondary	0.94	0.47 – 1.87	0.859
Household size			
1 to 5 people	1		
6 to 10 people	1.10	0.90 – 1.35	0.336
11 above	1.26	0.98 – 1.61	0.071
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	0.95	0.75 – 1.20	0.645
Severe Hunger	0.67	0.20 – 2.26	0.514
Marital status			
Single or never married	1		
Living together	2.25	0.20 – 24.8	0.509
Married	1.15	0.95 – 1.39	0.152
Separated/Divorced	1.56	0.69 – 3.52	0.282
Widowed	1.30	0.72 – 2.33	0.387
Locality			
Rural	1		
Urban	0.82	0.64 – 1.04	0.096
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	2.05	1.52 – 2.78	0.001
24 – 35 months	2.12	1.56 – 2.89	0.001
36 – 47 months	1.68	1.25 – 2.24	0.001
48 – 59 months	1.52	1.13 – 2.06	0.006
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	1.18	0.66 – 2.11	0.571
Mole-Dagbani	1.68	1.01 – 2.80	0.046
Gurma/Grushi/Mande	1.64	0.98 – 2.75	0.059
Other	1.76	0.88 – 3.54	0.112

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Sex of child			
Male	1		
Female	0.98	0.82 – 1.17	0.824
Sex of household head			
Male	1		
Female	0.85	0.64 – 1.11	0.226
Gendered Household			
Adult male, no adult female	1		
Adult female, no adult male	0.62	0.21 – 1.86	0.394
Male and, Female adults	0.71	0.26 – 1.95	0.500
FTF program			
Control	1		
Treated	1.13	0.95 – 1.36	0.166

4.4 Factors independently associated with underweight at midline

In the unadjusted analysis for underweight at midline, it was found that FTF program age and sex of child were significantly associated with underweight at the midline as shown in Table 7. Regarding the age of the children, those who were between the ages of 12 – 23 months had significantly higher odds of being underweight compared to those less than 12 months of age (OR 1.48, 95% CI 1.07 to 2.05). For sex of a child, female children had 20 percent lower odds of being underweight compared to their males (OR 0.80, 95% CI 0.65 to 0.98).

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Table 6: Factors independently associated with underweight at midline

Predictors of underweight	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	1.52	0.59 – 3.93	0.391
Islam	1.80	0.70 – 4.63	0.221
Traditional	1.60	0.61 – 4.19	0.341
Educational level			
No education	1		
Basic	1.23	0.85 – 1.78	0.274
Secondary	1.26	0.90 – 1.76	0.187
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	1.04	0.76 – 1.41	0.824
Severe Hunger	1.54	0.56 – 4.26	0.407
Marital status			
Single or never married	1		
Living together	0.95	0.28 – 3.16	0.930
Married	1.31	0.61 – 2.80	0.483
Separated/Divorced	0.99	0.38 – 2.57	0.987
Widowed	1.32	0.58 – 2.99	0.507
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	1.48	1.07 – 2.05	0.019
24 – 35 months	1.27	0.91 – 1.78	0.156
36 – 47 months	1.06	0.75 – 1.47	0.754
48 – 59 months	1.02	0.73 – 1.42	0.910
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	0.98	0.52 –1.84	0.957
Mole-Dagbani	1.11	0.66 –1.89	0.673
Gurma/Grushi/Mande	1.07	0.62 –1.86	0.799
Other	0.99	0.54 – 1.85	0.999
Sex of child			
Male	1		
Female	0.80	0.65 – 0.98	0.032
Subjective poor condition			
Very poor	1		
Poor	1.04	0.79 - 1.36	0.785
Neither	1.09	0.82 - 1.45	0.568
Rich	0.85	0.46 - 1.56	0.590
Very Rich	0.53	0.07 - 4.23	0.550
FTF program			
Control	1		
Treated	1.17	0.95 - 1.45	0.133

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4.5Adjusted logistic regression for factors associated with underweight at baseline

In the adjusted analysis (only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted analysis), the age of the child and ethnicity remained significantly associated with underweight at baseline as shown in Table 8. For age, the results for the adjusted analysis was similar to the one obtained in the unadjusted analysis. Thus, children 12 months old and above had a significantly higher odds of being underweight compared to those less than 12 months of age. Compared to the reference age, the adjusted odds of underweight were 2.08, 2.12, 1.67, and 1.52 for those aged 12 – 23, 24 – 35, and 36 – 47 and 48 – 59 months respectively. Also, in the case of ethnicity, similar results were obtained for the adjusted analysis compared to that of the unadjusted analysis. That is children from the Mole-Dagbani ethnic group had significantly higher odds of being underweight compared to the children from the reference ethnic, Akan (AOR1.68, 95% CI 1.00 to 2.81).

Table 7: Adjusted logistic regression for factors associated with underweight

Underweight	Adjusted OR	95%CI	P value
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	2.08	1.55 - 2.84	0.001
24 – 35 months	2.12	1.58 - 2.94	0.001
36 – 47 months	1.67	1.26 - 2.25	0.001
48 – 59 months	1.52	1.12 - 2.05	0.007
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	1.15	0.64 - 2.07	0.631
Mole-Dagbani	1.68	1.00 - 2.81	0.046
Gurma/Grushi/Mande	1.65	0.98 - 2.77	0.057
Other	1.76	0.87 - 3.56	0.113

4.6 Adjusted logistic regression for factors associated with underweight at midline

In the adjusted analysis (only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted analysis), the age of the child remained significantly

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associated with underweight at the midline as shown in Table 9. For age, the results for the adjusted analysis differed from the one obtained in the unadjusted analysis. The adjusted analysis showed statistical significance across all age groups. Children 12 months old and above had a significantly higher odds of being underweight compared to those less than 12 months of age. For example, compared to the reference category of less than 12 months, the odds of being underweight for children between the ages of 12 – 23 months and 24 – 35 months was more than double (AOR: 2.06 and 2.13 for those 12 – 23 months and 24 – 35 months respectively). For those in the ages of 36 – 47 months and 48 – 59 months, the odds of being underweight were 68 percent and 53 percent higher compared to the children in the reference age of less than 12 months respectively ((AOR 1.68, 95% CI 1.26 to 2.25), (AOR 1.53, 95% CI 1.13 to 2.07)).

Table 8: Adjusted logistic regression for factors associated with underweight at midline

	Adjusted OR		
Underweight		**95%CI**	**P value**
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	2.06	1.52 - 2.79	0.001
24 – 35 months	2.13	1.56 - 2.89	0.001
36 – 47 months	1.68	1.26 - 2.25	0.001
48 – 59 months	1.53	1.13 - 2.07	0.006
Sex of child			
Male	1		
Female	0.96	0.81 - 1.15	0.656

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4.7 Factors independently associated with stunting at baseline

In the unadjusted analysis for stunting at baseline, locality, age of a child, sex of household head, sex of a child, gendered household, and FTF program were significantly associated with stunting at baseline as shown in Table 10. For locality, living in the urban area had 21 percent lower odds of being stunted compared to those in the rural area (OR 0.79, 95% CI 0.65 to 0.96). For age, children who were 12 months old and above had a significantly higher odds of being stunted compared to those less than 12 months. For example, the odds of being stunted for children between the ages 36 – 47 months are three times more compared to the reference category of less than 12 months (OR 3.29, 95% CI 2.58 to 4.21). Also, compared to the reference category of children less than 12 months, the odds of being stunted for children between the ages 12 – 23, 24 – 35 months, and 48 – 59 were more than double (OR: 2.33, 2.52 and 2.83 respectively).

For sex of household head, children in female-headed households had 27 percent lower odds of being stunted compared to males (OR 0.73, 95% CI 0.58 to 0.92). The odds of a female child being stunted compared to a male was reduced by 17 percent (OR 0.83, 95% CI 0.71 to 0.96). Concerning the gendered household type, children who belong to an adult female-gendered household and male and, the female-gendered households had 80 percent and 74 percent lower odds of being stunted compared to those who belong to an Adult male, no female-gendered household respectively ((OR 0.20, 95% CI 0.07 to 0.57), (OR 0.26, 95% CI 0.10 to 0.70)). For those who benefitted from the FTF program, the odds of being stunted were 21 percent higher compared to those who did not receive the program (OR 1.21, 95% CI 1.05 to 1.41).

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Table 9: Factors independently associated with stunting at baseline

Predictors of Stunting	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	0.89	0.49 - 1.61	0.698
Islam	1.06	0.59 - 1.91	0.851
Traditional	0.96	0.53 - 1.76	0.901
Other	0.57	0.14 - 2.40	0.447
Educational level of HH			
No education	1		
Basic	1.10	0.77 - 1.58	0.604
Secondary	1.01	0.57 - 1.79	0.963
Household size			
1 to 5 people	1		
6 to 10 people	1.05	0.89 - 1.24	0.575
11 above	1.02	0.83 - 1.26	0.848
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	1.00	0.82 - 1.21	0.992
Severe hunger	0.51	0.19 - 1.40	0.192
Marital status			
Single or never married	1		
Living together	0.87	0.08 - 9.60	0.909
Married	1.03	0.88 - 1.21	0.682
Separated/Divorced	0.78	0.35 - 1.73	0.543
Widowed	0.69	0.40 - 1.18	0.174
Locality			
Rural	1		
Urban	0.79	0.65 - 0.96	0.018
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	2.33	1.78 - 3.03	0.001
24 – 35 months	2.52	1.93 - 3.29	0.001
36 – 47 months	3.29	2.58 - 4.21	0.001
48 – 59 months	2.83	2.20 - 3.64	0.001
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	0.85	0.56 - 1.29	0.460
Mole-Dagbani	0.97	0.68 - 1.39	0.878
Gurma/Grushi/Mande	1.03	0.72 - 1.49	0.861
Other	1.06	0.62 - 1.85	0.818
Sex of child			
Male	1		
Female	0.83	0.71 - 0.96	0.010
Sex of household head			
Male	1		
Female	0.73	0.58 - 0.92	0.006

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Gendered Household			
Adult male, no adult female	1		
Adult female, no adult male	0.20	0.07 - 0.57	0.002
Male and, Female adults	0.26	0.10 - 0.70	0.007
FTF program			
Control	1		
Treated	1.21	1.05 - 1.41	0.010

4.8 Factors independently associated with stunting at midline

In the unadjusted analysis for stunting at midline, age of a child, sex of a child, and FTF program were significantly associated with stunting at the midline as shown in Table 11. For age of children, those who were 12 months old and above had significantly higher odds of being stunted compared to those less than 12 months of age. For example, the odds of being stunted for children between the ages of 12 – 23 months is four times higher compared to the reference category of less than 12 months (OR 4.08, 95% CI 2.86 to 5.80). Also, compared to the reference category of children less than 12 months, the odds of being stunted for children between the ages 24 – 35 months, and 36 – 47 were three times higher (OR: 3.53, and 3.77 respectively). Also, the odds of being stunted for age 48 – 59 months was more than double compared to the reference category of less than 12 month (OR 2.72, 95% CI 1.92 to 3.86). Concerning sex of a child, being a female child had 17 percent lower odds of being stunted compared to males (OR 0.83, 95% CI 0.69 to 1.00). For those who benefitted from the FTF program, the odds of being stunted was 24 percent higher compared to those who did not receive the program (OR 1.24, 95% CI 1.03 to 1.50).

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Table 10: Factors independently associated with stunting at midline

Stunting	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	1.13	0.54 - 2.39	0.739
Islam	1.2	0.57 - 2.50	0.631
Traditional	1.01	0.47 - 2.15	0.984
Educational level			
No education	1		
Basic	1.14	0.81 - 1.59	0.446
Secondary	1.14	0.83 - 1.56	0.417
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	1.19	0.90 - 1.56	0.225
Severe Hunger	1.21	0.45 - 3.25	0.701
Marital status			
Single or never married	1		
Living together	0.57	0.19 - 1.68	0.309
Married	1.10	0.59 - 2.05	0.767
Separated/Divorced	0.99	0.45 - 2.19	0.985
Widowed	1.15	0.58 - 2.27	0.690
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	4.08	2.86 - 5.80	0.001
24 – 35 months	3.53	2.48 - 5.02	0.001
36 – 47 months	3.77	2.67 - 5.33	0.001
48 – 59 months	2.72	1.92 - 3.86	0.001
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	0.82	0.49 - 1.42	0.493
Mole-Dagbani	0.85	0.54 - 1.32	0.478
Gurma/Grushi/Mande	0.82	0.51 - 1.30	0.404
Other	0.79	0.47 - 1.35	0.399
Sex of child			
Male	1		
Female	0.83	0.69 - 1.00	0.045
Subjective poor condition			
Very poor	1		
Poor	0.97	0.76 - 1.23	0.784
Neither	0.91	0.71 - 1.18	0.490
Rich	0.75	0.45 - 1.27	0.286
Very Rich	1.51	0.42 - 5.42	0.529

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FTF program			
Control	1		
Treated	1.24	1.03 - 1.50	0.021

4.9 Adjusted logistic regression for factors associated with stunting at baseline

In the adjusted analysis (only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted analysis), locality, age of a child, Sex of child, sex of household head, gendered household, and FTF program remained significantly associated with stunting at baseline as shown in Table 12.

Similar results were obtained from the unadjusted analysis at baseline. For example, residing in the urban area still had 21 percent lower odds of being stunted compared to those in the rural area (AOR 0.79, 95% CI 0.65 to 0.97). For age of a child, those who were 12 months old and above had significantly higher odds of being stunted compared to those less than 12 months of age. For example, the odds of being stunted for children between the ages of 36 – 47 months were more than three times higher compared to the reference category of less than 12 months (AOR 3.27, 95% CI 2.55 to 4.18). Compared to the reference category of children less than 12 months, the odds of being stunted for children between the ages 12 – 23, 24 – 35 months, and 48 – 59 were more than double (AOR: 2.37, 2.55, and 2.84 respectively).

For sex of household head, children in female-headed households had 24 percent lower odds of being stunted compared to males (AOR 0.76, 95% CI 0.57 to 1.00). Female children had 20 percent lower odds of being stunted compared to males (AOR 0.80, 95% CI 0.69 to 0.92). The similarities that existed between the unadjusted and adjusted analyses continued to affect the rest of the variable as presented in Table 12. Concerning gendered household type,

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children who belonged to a male and female gendered household had 66 percent lower odds of being stunted compared to those who belonged to an adult male, no female-gendered household (AOR 0.30, 95% CI 0.12 to 0.83). For those who benefitted from the FTF program, the odds of being stunted was 19 percent higher compared to those who did not receive the program (AOR 1.19, 95% CI 1.02 to 1.39).

Table 11: Adjusted logistic regression for factors associated with stunting at baseline

Stunting	Adjusted OR	95%CI	P value
Locality			
Rural	1		
Urban	0.79	0.65 - 0.97	0.023
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	2.37	1.81 - 3.09	0.001
24 – 35 months	2.55	1.95 - 3.34	0.001
36 – 47 months	3.27	2.55 - 4.18	0.001
48 – 59 months	2.84	2.21 - 3.66	0.001
Sex of child			
Male	1		
Female	0.80	0.69 - 0.92	0.003
Sex of household head			
Male	1		
Female	0.76	0.57 - 1.00	0.051
Gendered Household			
Adult male, no adult female	1		
Adult female, no adult male	0.34	0.12 - 1.03	0.056
Male and Female adults	0.30	0.12 - 0.83	0.019
FTF program			
Control	1		
Treated	1.19	1.02 - 1.39	0.023

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4.10 Adjusted logistic regression for factors associated with stunting at midline

In the adjusted analysis for stunting at the midline (only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted analysis), age, sex of child, and FTF program remained significantly associated with stunting as shown in Table 13.

For age of children, those who were 12 months old and above had significantly higher odds of being stunted compared to those less than 12 months of age. For example, the odds of being stunted for children between the ages of 12 – 23 months were four times higher compared to the reference category of less than 12 months (AOR 4.10, 95% CI 2.85 to 5.78). also compared to the reference category of children less than 12 months, the odds of being stunted for children between the ages 24 – 35 months, and 36 – 47 is three times higher (AOR: 3.56, and 3.80 respectively). Also, the odds of being stunted for age 48 – 59 months was more than double compared to the reference category of less than 12 months (AOR 2.73, 95% CI 1.93 to 3.87). Concerning sex, female children had 27 percent lower odds of being stunted compared to males (AOR 0.83, 95% CI 0.69 to 1.00). Whilst for those who benefitted from the FTF program, the odds of being stunted was 24 percent higher compared to those who did not receive the program (AOR 1.24, 95% CI 1.03 to 1.50).

Table 12: Adjusted logistic regression for factors associated with stunting at midline

Stunting	Adjusted OR	95%CI	P-value
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	4.10	2.85 - 5.78	0.001
24 – 35 months	3.56	2.50 - 5.06	0.001
36 – 47 months	3.80	2.69 - 5.38	0.001
48 – 59 months	2.73	1.93 - 3.87	0.001
Sex of child			
Male	1		
Female	0.83	0.69 - 1.00	0.059
FTF program			
Control	1		
Treated	1.27	1.04 - 1.54	0.017

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4.11 Factors independently associated with wasting at baseline

In the unadjusted analysis for wasting at baseline, the FTF program, age of a child was significantly associated with wasting at baseline. For age, those who were 24 months old and above had a significantly lower odds of being wasted compared to those less than 12 months. For example, compared to the reference category of less than 12 months, children between 24 – 35 months had 55 percent lower odds of being wasted (OR 0.45, 95% CI 0.31 to 0.66) (Table 14). Those within ages 36 – 47 months and 48 – 59 months had 66 percent and 67 percent lower odds of being wasted compared to those less than 12 months (OR: 0.34 and 0.33 respectively).

Table 13: Factors independently associated with wasting at baseline

Wasting	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	0.65	0.30 - 1.42	0.282
Islam	0.72	0.33 - 1.56	0.410
Traditional	0.60	0.27 - 1.33	0.206
Other	0.49	0.06 - 4.33	0.520
Educational level of HH			
No education	1		
Basic	1.10	0.63 - 1.91	0.737
Secondary	0.69	0.25 - 1.92	0.477
Household size			
1 to 5 people	1		
6 to 10 people	0.82	0.63 - 1.07	0.141
11 above	1.28	0.95 - 1.72	0.109
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	0.80	0.58 - 1.10	0.169
Severe Hunger	1.21	0.36 - 4.12	0.760
Marital status			
Single or never married	1		
Living together	1	-	-
Married	1.08	0.85 - 1.39	0.525
Separated/Divorced	2.10	0.78 - 5.68	0.142

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Widowed	0.67	0.27 - 1.68	0.392
Locality			
Rural	1		
Urban	1.05	0.79 - 1.41	0.729
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	0.89	0.65 - 1.20	0.439
24 – 35 months	0.45	0.31 - 0.66	0.001
36 – 47 months	0.34	0.24 - 0.48	0.001
48 – 59 months	0.33	0.23 - 0.48	0.001
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	0.76	0.35 - 1.64	0.481
Mole-Dagbani	1.53	0.81 - 2.90	0.188
Gurma/Grushi/Mande	1.52	0.80 - 2.91	0.198
Other	1.84	0.77 - 4.39	0.167
Sex of child			
Male	1		
Female	1.01	0.80 - 1.26	0.942
Sex of household head			
Male	1		
Female	0.87	0.61 - 1.24	0.453
Gendered Household			
Adult male, no adult female	1		
Adult female, no adult male	0.75	0.41 - 1.38	0.356
Male and Female adults	1	-	-
FTF program			
Control	1		
Treated	1.13	0.95 - 1.36	0.166

Since Age category of children was the only statistically significant variable, multiple logistic regression for wasting at baseline was not considered.

4.12 Factors independently associated with wasting at midline

Similar results from the unadjusted analysis at baseline were obtained at the midline. FTF program and age of child was associated with wasting significantly at the midline. For age, those who were 26 months old and above had a significantly lower odds of being wasted

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compared to those less than 12 months. Compared to the reference category of less than 12 months, children between ages 36 – 47 months and 48 – 59 had 40 percent and 53 percent lower odds of being wasted ((OR 0.60, 95% CI 0.42 to 0.68), (OR 0.47, 95% CI 0.32 to 0.68)) respectively (Table 15). Those within the ages of 24 – 35 months had 28 percent lower odds of being wasted compared to those less than 12 months although this was not statistically significant (OR: 0.72).

Table 14: Factors independently associated with wasting at midline

Wasting	Unadjusted OR	95%CI	P-value
Religion			
No religion	1		
Christianity	2.57	0.61 - 10.81	0.198
Islam	3.50	0.84 - 14.58	0.086
Traditional	4.13	14.58 -17.47	0.054
Educational level			
No education	1		
Basic	1.26	0.84 - 1.90	0.269
Secondary	1.34	0.92 - 1.94	0.122
Household hunger scale			
No or little hunger in HH	1		
Moderate hunger in HH	1.00	0.71 - 1.41	0.999
Severe Hunger	0.78	0.23 - 2.62	0.693
Marital status			
Single or never married	1		
Living together	2.41	0.71 - 8.21	0.161
Married	1.72	0.68 - 4.35	0.248
Separated/Divorced	1.77	0.60 - 5.23	0.305
Widowed	2.05	0.77 - 5.45	0.153
Age category of children 0 to 5			
< 12 months	1		
12 – 23 months	1.00	0.72 - 1.38	0.979
24 – 35 months	0.72	0.51 - 1.02	0.064
36 – 47 months	0.60	0.42 - 0.86	0.005
48 – 59 months	0.47	0.32 - 0.68	0.001
Ethnicity			
Akan	1		
Ga-Dangme/ Ewe/ Guan	1.38	0.68 - 2.81	0.371
Mole-Dagbani	1.58	0.87 - 2.85	0.131

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Gurma/Grushi/Mande	1.76	0.95 - 3.23	0.072
Other	1.16	0.57 - 2.34	0.688
Sex of child			
Male	1		
Female	1.00	0.80 - 1.26	0.98
Subjective poor condition			
Very poor	1		
Poor	1.19	0.87 - 1.63	0.267
Neither	1.36	0.99 - 1.88	0.061
Rich	1.00	0.51 - 1.97	0.993
Very Rich	0.68	0.09 - 5.32	0.710
FTF program			
Control	1		
Treated	1.16	0.92 - 1.47	0.198

4.13 Difference-in-difference estimation for the prevalence of underweight comparing baseline to midline

At baseline, the prevalence of underweight was 17.9 percent and 19.8 percent for the control and treated groups respectively. The variance in the prevalence of underweight for the two groups at baseline was 1.9 percent with a p-value of 0.162. Hence at a significant level of 5 percent, there was no statistically significant difference in underweight for the control and treated groups at baseline.

Similar results were observed for underweight at the midline. With a prevalence of 16.7 percent for the control and 19.1 percent for the treated group, the test for difference in prevalence resulted in a p-value of 0.635. It can, therefore, be concluded that even after the introduction of the FTF program, there was no statistically significant difference in the prevalence of underweight for children in the control and treated groups. Also, from the results of the crude DID analysis, there was no statistically significant difference in the

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prevalence of underweight for the treated compared to the control groups at midline as shown in Table 16.

Table 15: Crude DID estimates for underweight

Underweight		No. of children. (% total)	No. underweight (% underweight)	Diff (p-value)	Crude DID (p-value)
Baseline	Control	1382 (42.3)	247 (17.9)	1.9% (0.162)	0.4% (0.841)
	Treated	1884 (57.7)	373 (19.8)		
Midline	Control	1105 (45.2)	211 (19.1)	1.5% (0.635)	
	Treated	1337 (54.8)	275 (20.6)		

**Inference: ***p<0.01; **p<0.05; *p<0.1

4.14 Adjusted difference-in-difference estimation for the prevalence of underweight comparing baseline to the midline

After adjusting for age, sex of a child, and ethnicity (only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted DID analysis), the difference in the prevalence of underweight at baseline was 1.7 percent with a p-value of 0.227. Hence at a significant level of 5 percent, there was no statistically significant difference in adjusted underweight estimates for the control and treated groups at baseline.

Similarly, after adjusting for age, sex of a child, and ethnicity at midline, the difference in the prevalence of underweight was 1.1 percent with a p-value of 0.718. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted underweight estimates for the control and treated group at baseline.

From the analysis, the DID estimate was 0.5 percent with a p-value of 0.803. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted difference-in-difference estimate of underweight for the treated and control groups at

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midline compared to the difference in the prevalence of underweight for the treated and control group at baseline as shown in Table 17.

Table 16: Adjusted DID estimates for underweight

Underweight		% Malnourished	Diff (p-value)	Adjusted DID (p-value)
Baseline	Control	17.0	1.7% (0.227)	0.5% (0.803)
	Treated	18.7		
Midline	Control	18.3	1.1% (0.718)	
	Treated	19.4		

Estimates were adjusted for Locality, Age category of children 0 to 5, Sex of child, and Ethnicity.
**Inference: ***p<0.01; **p<0.05; *p<0.1

4.15 Difference-in-difference estimates for the prevalence of stunting comparing baseline to the midline

At baseline, the prevalence of stunting was 33.8 percent versus 38.3 percent for the control and treated group respectively. The difference in the prevalence of stunting for the two groups at baseline was 4.5 percent with a p-value of 0.008. Hence at a significant level of 5 percent, there was a statistically significant difference in stunting for the treated group compared to the control group at baseline.

At midline, with a prevalence of 27.2 percent for the control and 31.8 percent for the treated group, the test for difference in prevalence resulted in a p-value of 0.264 (Table 18). Hence at a significant level of 5.0 percent, it can, therefore, be concluded that even after the introduction of the intervention, there was no statistically significant difference in the prevalence of stunting for children in the treated and control group.

Also, from the results of the DID analysis, the difference obtained was 0.1 percent with the p-value=0.981. Hence at a significant level of 5.0 percent, there was no statistically significant difference in the prevalence of stunting for the treated and control groups at

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midline compared to the difference in the prevalence of stunting for the treated and control group at baseline as shown in Table 18.

Table 17: Crude DID estimates for stunting

Stunting		No. of children. (% total)	No. stunted (% stunted)	Diff (p-value)	Crude DID (p-value)
Baseline	Control	1370 (43.4)	463 (33.8)	4.5% (0.008***)	0.1% (0.981)
	Treated	1788 (56.6)	684 (38.3)		
Midline	Control	1013 (46.4)	408 (40.3)	4.4% (0.264)	
	Treated	1171 (53.6)	523 (44.7)		

**Inference: ***p<0.01; **p<0.05; *p<0.1

4.16 Adjusted difference-in-difference estimates for the prevalence of stunting comparing baseline to the midline

Only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted DID analysis. After adjusting for age, sex of a child, gendered household head, and sex of household head, the difference in the prevalence of stunting at baseline was 4.2 percent with a p-value of 0.013. Hence at a significant level of 5 percent, there was a statistically significant difference in the adjusted estimates of stunting for treated compared to the control group at the midline.

After repeating the covariates in the midline adjusted analysis, the difference in the prevalence of stunting was 4.1 percent with a p-value of 0.288. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted estimates for stunting for the control and treated group at the midline.

The DID analysis resulted in a p-value of 0.998 as shown in Table 19. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted DID estimate of stunting for the treated and control group at midline compared to the difference in the prevalence of stunting for the treated and control group at baseline.

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Table 18: Adjusted DID estimates for stunting

Stunting		% Malnourished	Diff (p-value)	Adjusted DID (p-value)
Baseline	Control	27.6	4.2% (0.013**)	0.1% (0.988)
	Treated	31.7		
Midline	Control	34.1	4.1% (0.288)	
	Treated	38.2		

Estimates were adjusted for Locality, Age category of children 0 to 5, Sex of child, Gendered household head, and Sex of household head.

**Inference: ***p<0.01; **p<0.05; *p<0.1

4.17 Difference-in-difference estimates for the prevalence of wasting comparing baseline to the midline

At baseline, the prevalence of wasting was 10 percent and 90 percent for the control and treated group respectively. The difference in the prevalence of wasting for the two groups at baseline was 2.2 percent with a p-value of 0.066. Hence at a significant level of 5 percent, there was no statistically significant difference in wasting for the control and treated group at baseline.

Similar results were observed for wasting at the midline. With a prevalence of 12.8 percent for the control and 14.5 percent for the treated group, the test for difference in prevalence resulted in a p-value of 0.339 (Table 20). It can, therefore, be concluded that even after the introduction of the intervention, there was no statistically significant difference in the prevalence of wasting for children in the control and treated group.

Also, from the results of the DID analysis, the p-value recorded was 0.816 though there was a reduction of -0.4 percentage points (Table 20). Hence there is no statistically significant difference in the prevalence of wasting for the treated and control group at midline compared to the difference in the prevalence of wasting for the treated and control group at baseline as shown in Table 20.

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Table 19: Crude DID estimates for wasting

Wasting		No. of children. (% total)	No. wasted (% wasted)	Diff (p-value)	Crude DID (p-value)
Baseline	Control	1414 (42.1)	141 (10.0)	2.2% (0.066*)	-0.4% (0.816)
	Treated	1947 (57.9)	237 (12.2)		
Midline	Control	1311 (45.2)	94 (7.2)	2.6% (0.339)	
	Treated	1589 (54.8)	155 (9.8)		

**Inference: ***p<0.01; **p<0.05; *p<0.1

4.18 Adjusted difference-in-difference estimates for the prevalence of wasting comparing baseline to the midline

Only significant variables (p-value <0.05) from the unadjusted analysis were included in the adjusted DID analysis. After adjusting for the age of a child, the difference in the prevalence of wasting at baseline was 2.3 percent with a p-value of 0.053. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted estimates of wasting for the control and treated group at baseline.

After repeating the above-adjusted analysis at midline, the difference in the prevalence of wasting was 2.6 percent with a p-value of 0.340. Hence at a significant level of 5 percent, there was no statistically significant difference in the adjusted estimates for wasting for the control and treated group at the midline.

The adjusted DID analysis resulted in a p-value of 0.868 as shown in Table 21. Although not reaching statistical significance, the FTF program has reduced wasting by -0.3 percent for the treated group compared to the control group at the midline.

Table 20: Adjusted DID estimates for wasting

Wasting		% Malnourished	Diff (p-value)	Adjusted DID (p-value)
Baseline	Control	18.3	2.3% (0.053*)	-0.3% (0.868)
	Treated	20.6		
Midline	Control	16.3	2.6% (0.340)	
	Treated	18.9		

Estimates were adjusted for Age category of children 0 to 5.

**Inference: ***p<0.01; **p<0.05; *p<0.1

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CHAPTER FIVE

DISCUSSION

5.1 Prevalence of underweight, stunting, and wasting

Generally, the results of the present study were high but consistent with levels reported in other studies. The prevalence at both time points as shown in Figures 3, 4, and 5 were lower compared to the African region prevalence (39%) and Asia (55%) (UNICEF/WHO/World Bank, 2019).

5.1.1 Prevalence of underweight

The baseline prevalence of underweight recorded was 17.9 percent versus 19.8 percent in the control and the treated group respectively. However, there was a drop in both estimates at the midline (16.7 and 19 percent respectively). Considering the prevalence at midline, these results were similar to what was reported by Atsu et al. (2017), they reported a prevalence of underweight to be 17.3 percent among Ghanaian children who were under five years old using the Multiple Indicator Cluster Survey 4 data (Atsu et al., 2017).

Comparing the prevalence of underweight within the treated and control groups for the present study, children from the treated group (Northern region) were more likely to suffer from underweight without the FTF program. This result is in line with what was observed from the Africa RISING project (the program intent was to improve household nutrition through agriculture) as reported by Glover-Amengor et al (2016). They reported that "the levels of stunting, underweight and wasting in the Northern region was about three times the levels in the Upper West or Upper East region" (Glover-Amengor et al., 2016). The prevalence of underweight observed in the treated and control group at midline was 3.7 percent and 6 percent higher compared to the national estimate of 13 percent respectively

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(MICS, 2017). This result is higher compared to a study conducted in South Africa that recorded a prevalence rate of 7.7 percent among 240 children aged 0 to 5 years attending primary health care clinics (Koetaanet al., 2018). Although the prevalence of underweight was high in both arms in the present study, it was rather lower compared to a study conducted in Northeast Ethiopia which recorded a prevalence of 24.8 percent of children between 6 to 59 months in a community-based cross-sectional study (Gebre, Reddy, Mulugeta, Sedik, & Kahssay, 2019).

However, the results of the present study contradict what was found in a study in Bangladesh, where 33 percent of the children studied were considered underweight (Das & Gulshan, 2017). Also, the results from the present study are better than what was reported in a study conducted in India, where they recorded a 25.7 percent prevalence of underweight (Gem, 2019). Considering the above figures, underweight in children under five years old remains a public health concern. The 2011 MICS report recorded a prevalence rate of 13.4 percent for underweight children nationally (MICS, 2011). This figure reduced to 13 percent in the 2017 MICS report, accounting for 0.4 percentage difference.

5.1.2 Prevalence of stunting

At baseline, the prevalence of stunting in the control and the treated arm was 33.8 percent versus 38.3 percent respectively which was higher compared to the 2011 MICS estimates of 22.7 percent (MICS, 2011) which represents the national estimate as at the time. The prevalence of stunting at midline saw a drop of 6.5 percent in both the control and the treated arm (from 33.8 to 27.3, and 38.3 to 31.8 percent respectively). Comparing these results to the 2017 MICS national estimate of stunting which stood at 18 percent, the situation is still not encouraging in the ZOI (MICS, 2017). From the above report, the Northern region

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recorded the highest prevalence of 29 percent as compared to the national average of 18 percent. Within the ZOI, children in the Northern region are more likely to be stunted compared to Upper East (18%), Upper West (15%) and, Brong-Ahafo (14%) (MICS, 2017).

The results of the present study at the midline are similar to what was observed in the AFRICA rising project baseline report especially among the control group. A prevalence rate of 27.2 percent was recorded in the same ZOI except for Brong-Ahafo (Glover-Amengor et al., 2016). The prevalence at baseline and midline is similar to the report by the WHO African region which stood at 38.0 percent for Africa (World Health Organization, 2016). The result observed at the midline is also similar to a study conducted in Pakistan which recorded a prevalence rate of 29.4 percent among children 0 to 5 years (S. Khan, Zaheer, & Safdar, 2019). From Nigeria, Akombi et al, (2017) recorded a 29 percent prevalence of stunting among children under five which is also similar to what was recorded in this study (Akombi et al., 2017). The midline results are lower compared to what was recorded (34.8%) in neighboring Burkina Faso among children under five years old (Poda et al., 2017).

In view of the results above, there is a need for stringent measures to be put in place to curb the malnutrition situation in northern Ghana.

5.1.3 Prevalence of wasting

The prevalence of wasting in the ZOI for the control and treated groups at baseline was 10 percent versus 12.2 percent respectively. These figures increased at midline; the control group recorded 12.8 percent accounting for a 2.8 percentage increase in wasting at the midline. The treated group on the other hand, recorded a prevalence rate of 14.5 percent,

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accounting for a 2.3 percentage increase in wasting at the midline. Comparing the baseline prevalence of wasting in both arms to the national prevalence (6.2%) as reported in the 2011 MICS report, these figures are higher. The prevalence of stunting recorded by the control group at midline was still higher compared to the national prevalence (7%). Unlike the control group, the 14.5 percent prevalence recorded by the treated group at the midline is more than double compared to the national prevalence of wasting (7%) (MICS, 2017). Considering the regional estimates of wasting according to the 2017 MICS report, the Northern region recorded the highest prevalence (9%) whilst Upper East (7%) and Brong-Ahafo (7%) figures were equal to the national figure with Upper West (6%) recording the lowest within the ZOI(MICS, 2017).

From the results of the present study, indications are that wasting is a critical problem within the Northern region. The result of the present study is consistent with a study conducted in Bangladesh among children under five, 15 percent of the children studied were wasted as recorded by the study (Das & Gulshan, 2017).

The present study results at the midline are not consistent with what was recorded in a study conducted in Nairobi, Kenya which recorded a 6.3 percent prevalence of wasting among children under five (Vita et al., 2019). Also, the results are not consistent with what was reported by Boah et al, (2019), a prevalence rate of 5.3 percent was recorded (Boah, Fusta Azupogo, Amporfro, & Abada, 2019). These percentages are higher compared to the global prevalence of wasting (7.3%), but are lower compared to the African region (28%) and are far better compared to Asia (68%) among children under five (UNICEF/WHO/World Bank, 2019).

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5.2 Factors independently associated with underweight

The results from the logistic regression analysis at both univariate and multivariate levels are reported on selected household and child characteristics; locality, ethnicity, religion, household size, household hunger scale, educational level of the household head, type of gendered household, subjective poor condition of the household, household head marital status and the FTF program were considered in the analysis.

At baseline, the age of children and ethnicity were associated with underweight. At midline, age and sex of children were found to be independently associated with underweight in the ZOI. Female children had 0.8 lower odds of being underweight compared to males (95%CI: 0.65-0.98, p-value=0.032). This result is consistent with a study by Tekile et al. (2019) who recorded that, female children were 0.856 times less probable to be underweighted as compared to males (Tekile et al., 2019).

In the multivariate analysis, children within the ages of 12 – 23 months were 2.08 times more likely to be underweight compared to those less than 12 months (95% CI: 1.55 to 2.84, p-value=0.001). The result from the present study is in line with the results of a study conducted in Eastern Nepal by Khatri (2017). Age of child was found to be significant with underweight in children under five years old in Eastern Nepal (Khatri, 2017). In that study, children who were aged 24 to 59 were 2.18 times more likely to be underweight compared to the reference of less than 24 months (Khatri, 2017).

5.3 Factors independently associated with stunting

At both univariate and multivariate levels, the following selected household and child characteristics were reported on; locality, ethnicity, religion, household size, household

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hunger scale, educational level of the head of household, type of gendered household, subjective poor condition of the household, household head marital status, and the FTF program were considered in the analysis.

At baseline, locality, age of children, sex of children, sex of the household head, gendered household head, and FTF program were found to be associated with stunting. At midline, age and sex of children, and the FTF program were found to be associated with underweight in the ZOI. Compared to children living in a rural area, the odds of being stunted was reduced by 21 percent among those living in urban areas. This result is consistent with Tekile et al. (2019), where they found an association between locality (residence), age, and sex of child and stunting (Tekile et al., 2019). Also, the result of the present study is consistent with a Pakistani study where locality was found to be associated with stunting in children (S. Khan et al., 2019). This present study is again consistent with a study in Nigeria where the age of the child was found to be associated with stunting (Babatunde et al., 2011).

Moreover, the present study found that compared to males, the odds of being stunted among female children is reduced by 17 percent. This result is comparable to a study conducted in Ethiopia among children under five where the likelihood of being stunted among female children was reduced by 16 percent compared to males (Tekile et al., 2019).

Moreover, the present study has shown that the odds of being stunted was more prevalent among children who are 12 years and older (Tables 12 &13). This result is similar to what was reported by Boah et al. (2019) analysis of the 2014 GDHS. In their study, stunting was more dominant among children aged 12 years and older in Ghana (Boah et al., 2019).

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5.4 Factors independently associated with wasting

At both baseline and midline, the following selected household and child characteristics were included in the univariate analysis; locality, ethnicity, religion, household size, household hunger scale, educational level of the household head, gendered household type, subjective poor condition of the household, household head marital status, and the FTF program. However, apart from the age of children, the remaining variables were not statistically significant at both time points.

The present study found that the age of children for those who were 26 months old and above had a significantly lower odds of being wasted compared to those less than 12 months of age. Boah et al. (2019) similarly observed that child age was associated with wasting (Boah et al., 2019).

Although previous studies (Boah et al., 2019; S. Khan et al., 2019; Talukder, 2017; Tekile et al., 2019) found that sex of children, locality, household size, education level of household heads were associated with wasting, the present study did not establish this. Also, gendered household type, ethnicity, and religion were not found to be associated with stunting from the results of this present study.

5.5 Impact of the FTF program on underweight

The results from the model showed that the program statistically did not make an impact on the treated as compared to the control group. A positive percentage difference estimate suggests an increase in underweight whilst a negative percentage difference estimate means a reduction in underweight.

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At a significance level of 5 percent, a crude DID estimate of 0.4 percentage difference was obtained with a p-value=0.841 suggesting an increase in underweight in the treated as compared to the control group. After adjusting for other covariates (only significant variables (p-value <0.05) from the unadjusted analysis were considered in the adjusted DID analysis), an adjusted 0.5 percentage difference was obtained with a p-value=0.803. Hence at a significance level of 5 percent, the study concludes that the FTF program did not reduce underweight in children under five in the treated compared to the control group even after the program was introduced after the baseline survey.

Comparing the impact of the FTF program in the reduction of underweight to the SEECALINE program in Madagascar, the results from the SEECALINE evaluation showed that the program contributed to bridging the gap in underweight by 0.15–0.22 SD by the beneficiary communities (Galasso & Umapathi, 2009). The SEECALINE program had a protective effect on the biological outcome of the children, thereby preventing the beneficiary communities from suffering an increase in stunting (Galasso & Umapathi, 2009; IEG/World Bank/IFC/MIGA, 2010). The impact results of the present study on the reduction of underweight contrast with the Senegal Nutrition Enhancement Project which sought to extend nutrition and growth promotion intervention through NGOs focusing in rural areas. The program reduced underweight among children in beneficial villages than non-beneficial villages (Alderman et al., 2009). The impact results on underweight from the present study also contrast with the World Vision nutrition program in Haiti, where the program reduced underweight in children (Ruel et al., 2008). This study also contrasts with a conditional cash transfer program evaluation conducted in Nicaragua, the results showed that the program reduced underweight of children under five months by 9.8 percent in the

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beneficial communities whilst those in the non-beneficial communities increased to 16.6 percent (Maluccio & Flores, 2005).

However, the Thailand initiative to assist rural families to increase food production in the home through home gardens, a similar intervention of the FTF program, did not have any impact on underweight (Schipani, van der Haar, Sinawat, & Maleevong, 2002). Also, the Peru nutritional education program did not have any impact on underweight in children under five years (IEG/World Bank/IFC/MIGA, 2010).

5.6 Impact of the FTF program on stunting

On stunting, the crude DID estimate saw an increase of 0.1 percent with a p-value=0.981. Stunting had rather increased by 0.1 percent deducing from the above results instead of the desired reduction. Hence at a significance level of 5 percent, there was no reduction in stunting in the children who enjoyed the FTF program compared to those in the control group. After adjusting for other covariates (only significant variables (p-value <0.05) from the unadjusted analysis, significant factors were included in the adjusted DID analysis), similar estimates were obtained (DID=0.1%) with a p-value=0.988. Hence at a significance level of 5 percent, there was no reduction in stunting in the treated group at midline compared to the control.

The results from the present study contrast with an impact evaluation conducted on a conditional cash transfer (CCT) program on consumption in Colombia (Familias en Action), the program improved stunting in children between age 0 to 24 months old. From the same analysis, there was no improvement for children aged 24 to 72 months (Attanasio et al., 2005). In a similar evaluation conducted in Mexico, the “Oportunidades” program improved

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stunting in children aged 0 to 6 months, but this was different for children aged 6 to 12 or 12 to 24 months (Leroy et al., 2008). Also, a CCT program which was evaluated in Nicaragua saw 5.2 percentage points reduction in stunting among children under five (Maluccio, 2005).

However, a Thailand initiative to assist rural families to increase food production in the home through home gardens did not have any impact on stunting (Schipani et al., 2002). The program assisted rural Thailand families to produce fish, small animals, and vegetables which was similar to the FTF program in the ZOI. Moreover, another evaluation study conducted in Brazil (Bolsa Alimentacao) equally found no such impact in the reduction of stunting as demonstrated by the present study (IEG/World Bank/IFC/MIGA, 2010).

5.7 Impact of the FTF program on wasting

The results from the crude DID result in a reduction difference of -0.4 percent with a p-value of 0.816. Of course, there is a reduction in wasting but the p-value is not statistically significant. Hence at a significance level of 5 percent, the FTF program did not reduce stunting in the treated group compared to the control group.

After adjusting for the age of children, a -0.3 percentage points difference was obtained showing a reduction in wasting in children benefitted from the FTF program compared to those who did not. Although there was a -0.3 percent reduction in children who were wasted in the treated group, then again, the corresponding p-value of 0.868 is not statistically significant. Hence at a significance level of 5 percent, there is not enough statistical evidence to conclude that the reduction is a result of the impact of the FTF program. Other schools of thought suggest that this change might be due to some unobserved characteristics rather than the program (Torres-Reyna, 2010).

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Comparing the impact results on wasting from the present study to the World Vision community nutrition programs in Haiti, the program increased the weight-for-height of children by 0.24 percent compared to recuperative communities(IEG/World Bank/IFC/MIGA, 2010). In contrast to the Mexican "Oportunidades" program evaluation results, the program increased the wasting by 0.47 among 0 to 6 months children within the beneficiary communities (Leroy et al., 2008).

However, the CCT program on consumption did not have a positive effect on wasting(IEG/World Bank/IFC/MIGA, 2010; Maluccio, 2005). The Thailand program on mixed-gardening did not also have any positive impact on wasting among children within beneficiary villages as compared to those from non-beneficiary villages (Schipani et al., 2002). Furthermore, the Mexican "Oportunidades" program did not have an impact on wasting among children aged 6 to 12 or 12 to 24 months (Leroy et al., 2008). Again,

5.8 Strengths and limitations of the study

This study established baseline (2012) and midline (2015) estimates of the nutritional status of children in the FTF ZOI. Using the two-time points provided the opportunity to assess the impact of the FTF program even before the end line. The results from the study may not be conclusive since midline data was used in the analysis. However, the results will give us an initial assessment of the impact of the FTF and help program managers put in pragmatic strategies in the implementation of the program.

The study depended on a self-evaluation of poverty status which was answered by respondents. This may have biased the results on household wealth assets and income levels

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since it was subjective. The data was collected at midline only. Therefore, it was not included in the background characteristics of household and child (Table 5.) Also, data on caregivers' characteristics, unlike other studies (Adokiya, Baguune, & Ndago, 2017; Glover-Amengor et al., 2016), were not considered in the analysis of the present study due to some data constraints.

The results from the impact analysis from the present study may not be comparable to other evaluation studies due to variability in the local context, the length of exposure to the intervention, variation in the age of the children, and possible implementation capacity or challenges (IEG/World Bank/IFC/MIGA, 2010). Despite the above constraints, efforts were made to compare the results of the present study to other evaluation studies with a focus on reducing malnutrition in children under five.

The results from the present study may not be comparable to communities from other parts of the country. Nonetheless, the strength of this study includes the objective assessment of the impact of the FTF program on the reduction of malnutrition in the northern part of the country.

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CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The study was an assessment of the impact of the FTF program on the reduction of malnutrition in children under the Northern part of Ghana. The prevalence of underweight, stunting in the ZOI is above the 2017/18 Multiple Indicator Cluster Survey estimates of the three indicators (MICS, 2017). Therefore, there is a need to put in more effort to achieve the objective of the FTF program towards the reduction of malnutrition in children under-five.

Hypothetically, the treated group would have realized an appreciable change in the reduction of malnutrition more than those in the control group, but the trend observed in both arms makes it difficult to find causality or attribute any change to the program in question. The change that was observed in both groups suggested an increment in stunting and underweight instead of the desired reduction as occurred in wasting. It was expected that what should have happened in the control group should have been lower based on the assumption of the counterfactual.

Apart from wasting which saw a reduction of -0.4 percent reduction in crude DID and -0.03 percent in the adjusted DD which although was not statistically significant, the program did not reduce the prevalence of underweight and stunting even when the intervention was introduced after the baseline survey. Hence at a significant level of 5 percent, using the DID estimator, the study concludes that there was no established statistically significant difference in the prevalence of the three indicators even after the FTF program was introduced in the treated group at the midline as compared to the control group. The results

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also suggest that the program did not have significant short-term effects on the nutritional outcomes in the FTF ZOI. This result may change or improve when the final evaluation is done at the end of the FTF program.

6.2 Recommendation

Although this present study did not establish statistically significant results for the prevalence of underweight, stunting, and wasting among the treated group compared to the control groups, the following suggestions are recommended.

- Considering the highlights of the discussions, there is also the need to strengthen the M&E system of the implementing team to enhance surveillance, to be able to measure the effects of other interventions within the ZOI that may have similar objectives and are operating concurrently in the ZOI.
- The implementing team should enhance the frequency of field visits to beneficial households to document and witness how children under five years old are being fed and also document the feeding practices of the children of interest.
- There is also the need to investigate why the prevalence of underweight and stunting increased within the two groups at the midline. Based on the above, there is the need to build a strong collaboration with the Municipal and District Health directorate to fight against malnutrition in the various zones.
- Policymakers should provide pragmatic and sustainable nutritional programs towards the reduction of malnutrition in children under five within the ZOI.
- Conscious efforts should be made to bring to bear the challenges encountered in the implementation of the FTF programs in the Northern region to inform future projects.
- Another study could look at the overall impact of the FTF program on malnutrition at the end of the program.

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