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EVALUATION OF GHANA SCHOOL FEEDING PROGRAM: A CAUSAL MEDIATION ANALYSIS

By

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DECLARATION

I, Kojo Mensah Sedzro, declare that this work is the result of my own original research under the supervision of Dr. Samuel Bosomprah, and that inclusions of other peoples' research by way of references and literature review have been duly acknowledged. This dissertation, either in whole or in part has not been presented elsewhere for another degree.

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Date……..

Kojo Mensah Sedzro

(PH M&E student)

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Date …….

Dr. Samuel Bosomprah
(Academic Supervisor)

DEDICATION

This work is dedicated to all whose actions or inactions spurred me on.

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ABSTRACT

Introduction: School feeding programs (SFPs) deliver significant nutritional intervention during school children's critical growth period. Its effects on learning appear to work by both increasing school attendance and earning efficiency while at school. As part of the evaluation of the Ghana School Feeding Program (GSFP), the findings did not suggest any impact on the learning outcome, hence this research attempted to determine the mechanism by which the school feeding program (or not) impacts learning.

Methods: A randomized control cluster design was adapted to scale the GSFP across the 10 regions. Baseline data was collected in June 2013 and follow-up in March 2016. A total of 30 districts were randomized in both research rounds. A two-stage stratified random sampling design was used. Twenty-three and twenty-nine schools were randomized at the intervention stage: respectively, Home Grown School Feeding Pilot (HGSF+) and its control. The study district selection criteria were based on national poverty and food insecurity. Household inclusion criteria were limited to children aged 5 to 15 years.

Results: There was no significant association between learning outcome and treatment, HGSF+ (95% CI -2,25 to 1,64, P-value = 0,758). Likewise, there was also no significant interaction between mediator(weight-for-age) and treatment (95% CI -0.015 to 0.024, P-value = 0.636). The indirect effect of HGSF+ on the learning outcome through the mediator was 0.999 (95% CI: 0.972-1.032), and this is statistically significant.

Conclusion: There was no evidence that the enhanced school feeding program improves learning outcomes, findings of the study suggest the design, execution, and timing of the study were causes to the failed desired impact of the enhanced SFP on learning outcomes

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LIST OF ABBREVIATIONS

CDE	- Controlled Direct Effects
DAG	- Directed Acyclic Graph
GoG	- Government of Ghana
GSFP	- Ghana School Feeding Program
HGSF+	- Home Grown School Feeding Pilot
LMICS	- Lower Middle-Income Countries
MTE	-Marginal Total Effects
NDE	-Natural Direct Effects
NEA	- National Educational Assessment
NIE	-Natural Indirect Effects
SFP	- School Feeding Program
WFP	- World Food Program

CHAPTER ONE

INTRODUCTION

1.1 Background

Current existing literature point to the fact that millions of students in low- and middle-income countries (LMICs) lag behind in academic performance particularly basic literacy and numeracy. In a study assessing student literacy and numeracy in LMICs, Mullis et al. (2012) reported that students perform less than 95 percent in high-income countries. In another study among grade 6 students in West and Central Africa conducted in 2014, less than 45 percent reached the "sufficient" competency level for continuing studies in reading or mathematics (Malpel & Conférence des ministres de l'éducation des états d'expression française, 2015). According to the Global Monitoring Report on Education for All (UNESCO, 2014), about 250 million children in LMICs cannot read, write or do fundamental mathematics.

In the context of Ghana, the World Bank accountability report for learning outcomes projects in 2018, indicated that just 2 percent of primary two pupils were able to read at an appropriate grade level with 50 percent unable to recognize a single word (Mikesell, Deborah Newitter, 2018). In addition, the results of the 2016 National Education Assessment (NEA) also revealed that both English and Mathematics challenged primary school students, with no more than 37 percent of students attaining skill levels in any grade or subject. Performance was noticeably lower for mathematics than for English, with only 22 percent of Primary six pupils and 25 percent of Primary six pupils achieving proficiency

in mathematics compared to 37 percent of primary 4 pupils and 36 percent of primary 6 pupils achieving proficiency in English (*Ghana 2016 National Education Assessment: Report of Findings*, n.d.)

1.2 Problem Statement

The relatively low academic performance of students at these early grades are linked directly and indirectly among other factors to the nutritional status of the students. A number of studies have indicated that nutrition is essential to intellectual and brain development; well-nourished, disease-free children are better prepared to attend school and learn, making good food decisions a vital ingredient in the academic performance of school children. Globally, the adverse impacts of malnutrition on children's cognitive features are well founded, in particular the adverse effects of undernutrition (Averett and Stifel, 2007; Alaimo et al., 2001; Kaestner and Grossman, 2009; Taras, 2005). School feeding programs (SFPs) provide important nutritional intervention during the critical growth period of school children. Studies have demonstrated that SFPs alleviate short-term hunger and address deficiencies in micronutrients. The effects of SFPs on learning seem to work by both improving school attendance and enhancing the efficiency of learning while at school. Therefore, well run programs that provide fairly nutritious meals should have a beneficial effect on children's attendance at school, learning and nutritional intake. The magnitude of these impacts, however, relies on endogenous variables such as teaching quality, textbook accessibility, programmatic and contextual factors (Jomaa, McDonnell, & Probart, 2011). In estimating SFP's effect on learning outcomes, researchers are hoping to assess the

difference in outcomes that can be ascribed to the program's existence. As measured by increases in test scores, most empirical results suggest a positive effect on learning achievement.

In the context of the evaluation of the Ghana School Feeding Program (GSFP), the results suggested no effect on the learning outcome, which is why this research seeks to expand on the outcome why the enhancement of GSFP has not had the required effect on learning outcomes through causal mediation effects by exploring the role of nutrition-weight-for-age in the relationship between learning outcomes and enhance micronutrient, HGFSP+.

1.3 Justification

Traditionally, many countries have attempted to solve this poor learning outcome problem by targeting supply-side issues such as motivating and enhancing skills of teachers, improving school management and investment in school input. But these have not had the desired impact on learning outcomes over the years, primarily because there have not been targeted interventions on the learner or demand-side factors. Interventions such as nutrition programs to prepare the learner can be an effective solution. Children often arrive in school unprepared to learn - if they arrive at all. Malnutrition, illness, low parental investments, and the harsh environments associated with poverty undermine early childhood learning (Interaksyon, 2018). Severe deprivations - whether in terms of nutrition, unhealthy environments, or lack of nurture by caregivers - have long-lasting effects because they impair infants' brain development (World Development Report 2018,n.d.).

Thirty percent of children under the age of 5 in developing nations are physically stunted, which is typically due to chronic malnutrition. (World Development Report 2018, n.d.). The poor developmental foundations and lower levels of preschool skills resulting from deprivation mean many children arrive at school unprepared to benefit fully from it. So even in a good school, deprived children learn less. Moreover, breaking out of lower learning trajectories becomes harder as these children age because the brain becomes less malleable.

In Ghana, despite the fact that SFP has improved net enrollment and attendance, there is a lack of adequate evidence about its effect on school children's nutritional status and learning outcomes. Therefore, this study contributes to understanding the mechanisms by which the intervention exerts the impact of the learning outcome, thereby highlighting the difficulties that need to be addressed in designing and implementing SFPs.

1.4 Research Questions

This study sought to answer to the following questions:

(a) why did the intervention (HGSF+) fail?

(b) does the intervention not affect the mediator?

(c) does the mediator not affect the outcome?

(d) was the direct effect in the opposite direction of the mediated effect?

1.5 Research Objectives

The specific objectives of this study are:

1. To estimate the impact of school feeding program on learning outcomes.

2. To determine the mechanism by which the school feeding program impact (or not) learning

1.6 Research Hypothesis

1. The impact on learning (test scores) would be moderate as school quality is unlikely to change in the short term
2. The intervention would have a moderate direct effect on learning through an indirectly limited effect on physical growth of children due to substitution effects and the age range (5 to 15 years) of the targeted population and the increase in physical activity level of the children.

1.7 Theory of Change/Conceptual Framework

The impact theory of school feeding program (SFP) on agriculture, health, and education have been illustrated in very comprehensive terms in Figure 3 below. In line' a' in the figure, higher enrolment, attendance, and completion directly affects educational outcomes. SFP directly influences health by improving nutritional status (line' b'), which in turn has a positive impact on education as improving nutritional status has a positive effect on learning outcomes (line' d'). Increasing food security for households (line' c') can also directly influence income through intervention. Furthermore, the small enterprises involved in providing school food service would benefit from the intervention. (Gelli et al., 2016).

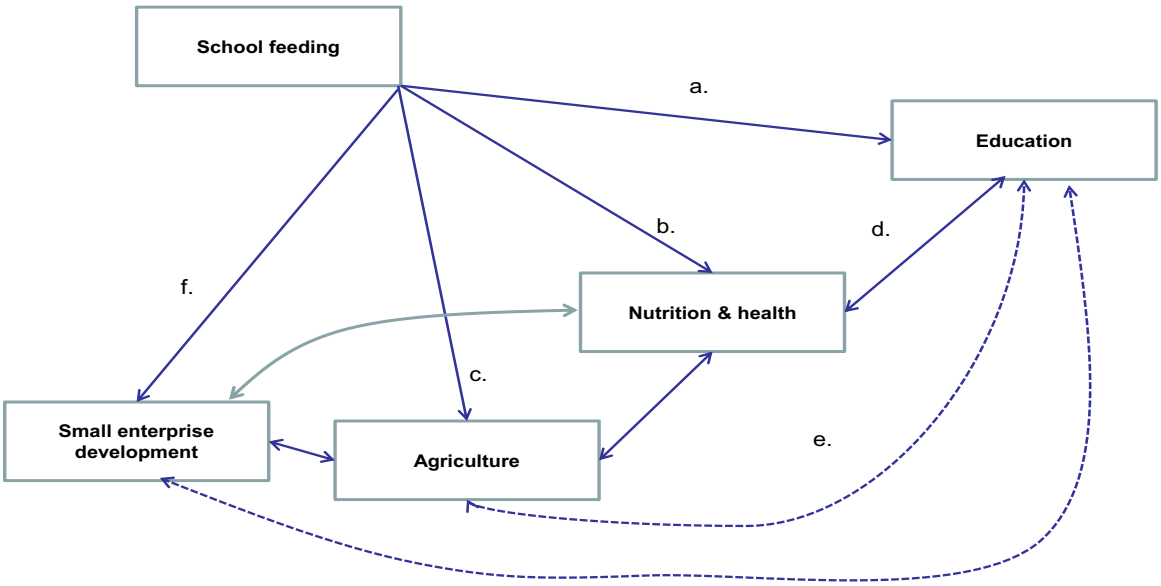

Figure 1: Overall concept of school feeding Program interventions

According to Gelli et al, (2016) a couple of recent research have studied the effect of school feeding programs on schooling and nutritional outcomes and have concentrated on the young, typically primary-school-aged children, and have generally found that there are positive treatment effects on participation and nutritional status. Gelli et al. (2016) evaluated the effects of the SFP on learning achievement in the context of the knowledge and practices of caterers on the preparation and delivery of school meals in a randomized controlled trial.

This study, however, focused on the pathway through which direct observable outcome variables such as weight-for-age, an indicator variable of nutrition effect, is mediated through the enhanced school feeding program (HGSF+).

Figure 2 shows the pathway through which the (1) indicator outcomes: treatment of School Feeding Program (HGSF+); (2) nutrition outcome: weight-for-age; and (3) learning outcomes: English and Mathematics standard test score, in this regard computed as an index score, was mediated. Variables such as children's age (5-15 years), child sex, household's head age and education level, and household size were included in all mediation models; measured as covariates of exposure-outcome variable and the mediator outcome pathways. The counterfactual approach to mediation analysis was used to estimate the School Feeding Program's Controlled Direct Effects (CDE), Natural Direct Effects (NDE), Natural Indirect Effects (NIE), and Marginal Total Effects (MTE), controlling measured covariates (Valeri and Vanderweele, 2013).

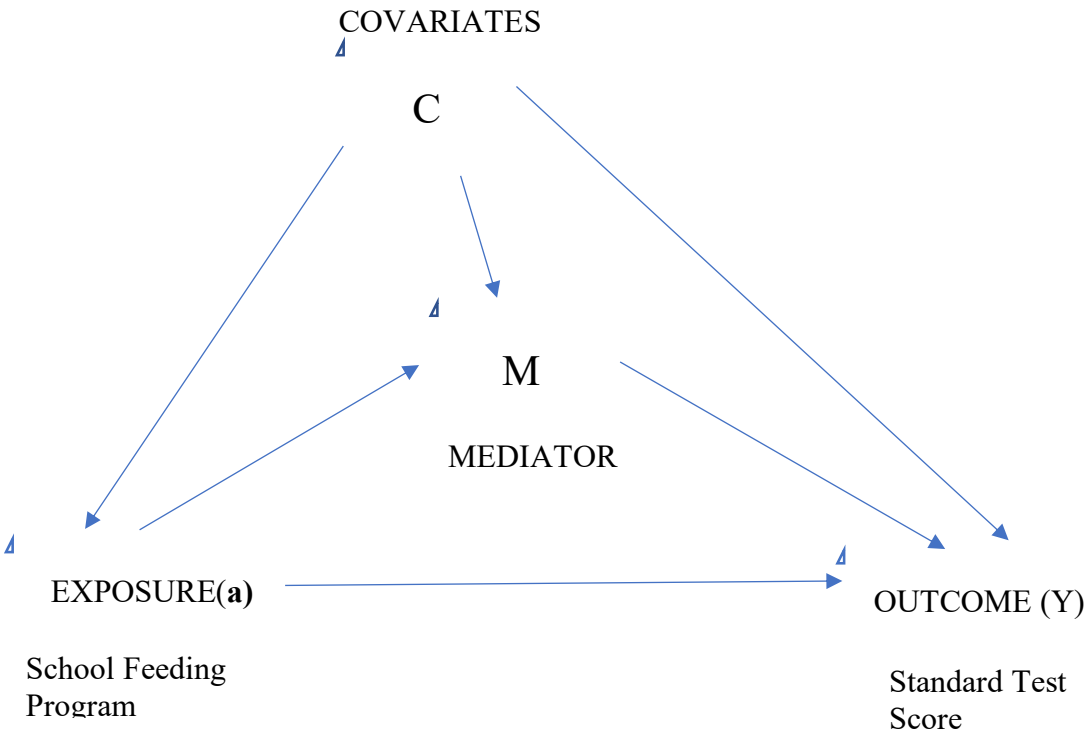

Figure 2: Mediation effects of Nutrition on School Feeding program and Learning outcomes

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section covers a review of the history and importance of Food for Education (FFE) programs, as well as the potential outcomes and impacts of these programs. It also includes a review of the nutrition and academic performance literature and a discussion of the Ghana SFP (GSFP) which serve as the context of the current study. Lastly, a summary of the review is presented in addition to a discussion of the knowledge gaps identified in the review.

2.2 Overview of Food for Education Programs

A Food for Education (FFE) program can be defined as a "targeted social safety net" intervention designed to achieve both health and educational outcomes among children from poor households (Yendaw & Dayour, 2015a), measured by a mix of indicators such as improvements in physiological well-being and cognitive abilities, improvement in nutrition, increased enrolment, and decreased absenteeism (Feleke et al., 2018). In the same vain, Abotsi (2013) asserts that FFE programs can be define in terms of their comprehensive and varied use of food for achieving measurable educational outcomes. Osei-Fosu (2011) adds that FFE programs are also design to motivate parents to send their children to school and ensure that the children regularly attend school (Osei-Fosu, 2011). According to De Carvalho et al. (2011) FFE programs have received substantial support from several inter-government agencies and international organizations.

The United Nations Millennium Project (UNMP, 2005) resolved that FFE programs must cover all vulnerable children facing severe hunger. FFE programs also plays an important role in the six 'Education for All" goals that forms part of the Dakar Framework for Action (UNESCO, 2015; World Food Program, 2015). FFEs are also recognized by the Comprehensive Africa Agriculture Development Program (CAADP) approved by the New Partnership for Africa's Development (NEPAD) in 2003, and later supported in 2006 at the African Union Food Security Summit held in Abuja (Yendaw & Dayour, 2014).

Adelman et al. (2008) suggests that FFE programs have recently become a widely implemented policy instrument for the attainment of universal primary education under the Millennium Development Goals. The author notes that, the programs are designed to attract and keep children in school through the provision of nutritious meals; and they are design to improve participation at school, as well as cognitive outcomes through the provision of nutritious foods.

Lawson (2012) argues that FFE programs typically target living in extreme poverty populations. The author further notes that, FFE programs are "visible social safety nets" deployed by politicians with its tangible impacts on school children seen by a participating community as a direct support from the politicians. In similar vein, Jomaa, McDonnell, and Probart (2010) observes that, as part of the potential nutritional outcomes, FFE programs are designed to yield improvement in certain cognitive functions and scholastic achievements, particularly with children who are malnourished. The author notes that FFE programs are therefore particular important in emerging countries where the highest

percentages of undernourished children live, and where the lowest enrollment against the highest dropout rates are recorded.

2.3. Models of Implementing the Food for Education Programs

According to Yendaw and Dayour (2015) FFE programs can be implemented under different principles, models and types. The WFP (2015) proposes five models for implementing SFPs, namely community-based and school-based models, decentralized and centralized models, and the combination model. Lawson (2012) indicates that in FFE programs there are two primary types of food distribution: School Feeding Programs (SFP) and Take-Home Rations (THR). SFPs offer meals or snacks to be consumed by the school children at school, whereas under THR programs children provided with food to consume at home. In SFPs, the food provided is either cooked-on-site or pre-packaged such as nutrients-packed biscuits.

The benefits derived from the school meal/snacks provided through SFPs is provisional on the child attendance at school on a specific day. Thus, SFPs have the advantage of providing an incentive for children to be at school during school days in order to participate from the intervention; Whereas in the case of THR programs, child benefits are derived from attending school for a specified minimum number of weeks, usually within one month. Yohannes (2017) notes that SFP meals are nutritionally dense and are usually fortified with supplementary nutrients to compensate for those that are scarce in the local diet of a particular community. The author further notes that targeting in SFPs is broad,

with all the children at a school fed the same meal. (WFP, 2004; Tomlinson, 2007; Lawson, 2012; Yohannes, 2017)

Tagoe (2018) notes that the coverage of SFP varies immensely depending on the capacity and size of the implementing country. For example, Yendaw and Dayour (2015) suggests that SFPs in low- income countries are basically designed to target specific category of school children in specific communities, whereas in middle- and high-income countries, there is usually the extension of the coverage to the general population of school children.

2.3.1 Implementation of Food for Education Programs

According to the Food and Agriculture Organization (FAO, 2005) the idea of providing food to needy children in schools started as early as 1790 in Munich, Germany and spread around the 1800s throughout Europe with the provision of lunch in schools. The implementation of FFE programs in its current organised form however dates back to the 1930's, when school feeding was introduced in both United Kingdom (UK) and United States of America (USA) with the provision of milk aimed at improving the overall growth of school children (Ramadhani, 2014). According to Swartz (2009), the first well-organised nationwide FFE programs was introduced in Brazil in 1945, known as the School Nutrition and Food Security Program (SNFSP). The government of Brazil, in implementing the SNFSP adopted a decentralized governance approach, and introducing the role of local school meal councils which were made up of representatives from government, civil society organizations, parents and teachers (WFP, 2009).

WFP (2015), suggests that among others FFE programs are implementable under different conditions such as conflict and post-disaster conditions, a crisis or state of emergency, under an unstable or stable economy. The WFP further suggests FFE programs can be tailored to meet targets and outcomes defined by national policies, with the targets and outcomes serving as the benchmark for their implementation.

FFE programs have been used over the years to meet the nutrition and food needs of school-aged children. Currently, almost every country around the world has implemented an FFE programs, and its estimated that 368 million children are feed at school every day from kindergarten through to secondary school (Yohannes, 2017). According to the WFP (2015) governments around the world have come to accept FFE programs as an essential tool for the growth and development of society as a whole, communities and children (WFP, 2015). WFP (2013) estimates suggest that while the coverage of FFE programs in middle-income countries is about 49%, the figure is around 18% for low-income countries. The statistics suggest that countries that have a greater need with regards to poverty, hunger, and other poor social indicators have the lowest coverage. According to Yohannes (2017) the WFP has been directly involved in the most extensive school feeding implementation around the world then any single international entity, "providing food for millions of school children and their families each year." The WFP was chiefly involved in the implementation of FFE programs in 64 countries, feeding early 16 million children in 2002 alone (WFP, 2004). The implementation of FFE programs, especially in the under-developed countries, have also received massive support from several donors (through bilateral programs) and international non-governmental organizations (Yohannes, 2017).

2.3.2 Critics Against the Implementation of the School Food Program

A number of criticisms have been registered against the various modalities in the implementation of the SFP. For instance, Vermeersch and Kremer (2004), suggests that the implementing of SFP is associated with negative educational and social implications. Vermeersch and Kremer argues that by only catering for the needs of school children, the SFP ignores the number of vulnerable children who come from poor households but are too week or too young to attend school. To the author, this defeats the basic purpose of catering for the nutritional needs for all children from poor households. In a similar vein, SFPs have been associated with academic underperformance among participating school children.

Several authors (including Vermeersch and Kremer, 2004; Meir et al. 2007; Kazianga et al. 2009) have criticized the teaching hours used that by school children to partake in the meals provided under the SFP, especially where some teachers are directly involved in the preparation of the meal. These critics argue that participating in SFP takes away valuable teaching hours, and this can lead to academic underperformance among participating school children.

The SFP has also been criticized as promoting enrollment rates in schools without complimenting infrastructure improvements leading to overcrowding in participating schools. He (2009), reports that infrastructure at participating schools is usually inadequate to support increases in enrollment, with children in such situations left to attend school under poor conditions.

In addition to this, the author further notes that SFPs affects teaching quality as overcrowding leads to a situation where a limited number of teachers are forced to teach classes larger than what they can adequately teach. In addition, Gilligan et al. 2008 notes that, in communities where the SFP is not implemented in all schools, school children could move to participating schools, disproportionately affecting both participating and nonparticipation schools, causing overcrowding in some and lower enrollment rates in other.

2.3.3 Challenges in Implementing School Feeing Programs (SFP)

Studies conducted to investigate the challenges in implementing SFPs has yielded several factors identified in the literature as having the potential to negatively affect on the successful implementation of the SFPs. The three major challenges, i.e. lack of adequate financial resources, regulatory and policy framework difficulties, and lack of parental and community involvement, are discussed in following subsections.

2.3.4 Inadequate Financial Resources

According to Kootnz and Wierch (2001) the major challenge to the implementation of SFPs around the world is the unstable funding source. Tagoe (2018) notes the successful execution of SFPs, just like other national program, strongly depends adequate funding commitments, usually by governments and other stakeholders. Ayieke (2005) also underpins this idea by noting that governments should include SFPs budgets directly in planning national fiscal budgets.

Olubayo et al (2013) suggests that even though sufficient resources are allocated for the implementation of SFPs in Nigeria, most programs do not have proper spending plan in place for their disbursement. Nkethia (2011) who found that participating schools in Kenya experience disruptions in implementing SFPs due to delays in the disbursement of funds, suggests that monies allocated to the implementation of SFPs should be timely disbursed to the implementing institutions.

2.3.5 Policy and Regulatory Network Problems

According to Chelangat (2011), in order to ensure a successful implementation of the SFP, there should be an institutional arrangement that is responsible for carrying out the program. The author also recommends that the institutions set to carry out the implementation of the program must have qualified and adequate staff to help in the implementation process and the system of operation must be transparent to the general public. In addition to this, WFP (2008) mentions that the implementation of the SFP must involve all stakeholders and the system must be monitored and evaluated. This according to Briggs (2008) will ensure a successful implementation of the program. However, a research conducted by Olubayo et al. (2013) on the SFP in Emuhaya county in Nigeria revealed that there is lack of adequate skilled personnel to successfully implement the program. The authors also mentioned that lack of transparency and effective communication between the policy network in charge of the problem were found to be a major challenge associated with the SFP implementation.

According to WFP (2013) and United Nations (2008), issues such as corruption, political instability and lack of proper monitoring and evaluation are also problems with the policy administrations that inhibit the successful implementation of the SFP in many developing countries.

2.3.6 Inadequate Parental and Community Involvement

According to Cole (2007), community involvement is key to the development and implementation of an SFP. Similarly, Tablot and Verrinder (2005) affirmed the proposition that community involvement is crucial in program implementation as it allows all stakeholders to participate in the decision-making process. Additionally, Briggs (2008) found that the development and implementation of a sound policy can be accomplished through the involvement of the community actors including community leaders, schools, parents, and children among others. Extending this to the implementation of the SFP, Young (2005) has argued that community and parental involvement are crucial in carrying out the program. According to Young (2005), "Implementation of SFP can be successful if the community can be consulted while designing the program if there are community-level structures for communication if there is a committee with parents and teachers…and if the community gets the motivation to execute their roles fully in providing SFP".

Furthermore, Nkethia (2011) indicated that the involvement of parents, teachers, and communities in decisions on the SFP provides them the opportunity to be aware of the impacts of the program on their children or students and their educational performances.

Despite the essential implications to involve community and parents in the implementation of the SFP, Nkethia (2011) found that community and parents have not been involved in the SFP implementation process in Kenya. Similarly, WFP (2008) also mentioned that not much energy has been expended to involve parents and the community in the implementation of the SFP in many countries. This affects how parents and the community members perceive the program and its impacts on their children.

2.4 Potential Outcomes and Impacts of FEPs

The potential outcomes of SFP interventions has been the subject of interest to various social and natural science disciplines over the past six decades. Serval of these studies focus on the health and educational improvement outcomes, the new trends in implementation, the potential to result in agriculture development or food security. Examples of authors who have studied SEPs in the different fields of study include, Dheressa (2011) Development Studies; Grillenberger et al., (2003) Economics; Mwavula (2014) Education; Hanushek (1986) Nutrition; Ermias (2015) Psychology; Asmamaw (2014) Public Health; and Hinrichs **(**2010) & Sagenge (2014) Policy Study.

According to Jomaa, McDonnell, and Probart (2010), empirical evidence in the FFE literature reveals that both types of FFE programs demonstrates a positive impact on both attendance and enrollment. The authors also report that; the literature on the effect of FFE programs on academic achievements shows a continuous progressive impact on mathematics testing, but comparatively reduced impacts on writing and reading testing. Jomaa, McDonnell and Probart who found that FFE programs results in improvements in academic achievements through a reduction in dropout rates, stipulates that, both THRs

and SFPs reduces dropout rates, more so among girls, and particularly when both FFE modalities are offered at the same school.

According to Del Rosso (1999 cited in Ramadhani, 2014), "SFPs acts as a strong incentive for children to attend school on a regular basis". The author who studied the impact of SFPs in Jamaica, found that attendance significantly increased when primary school children were given breakfast at school. Ramadhani (2014) in a similar vein suggests that SFPs mostly results in increase in enrolment and attendance among culturally disadvantaged girls. Ramadhani reasons that in such situations, "male children are given preference to go to school over girls. SFPs in such situations creates the opportunity for more girls be to enrolled and stay in school by eliminating the cost of feeding children on a household.

World Food Program (WFP) conducted a three-month pilot study in Malawi in 1996 and found that SFPs resulted in 5% increase enrollment and attendance also increased by up to 36% (WFP, 1996). A similar result was obtained in Burkina Faso around the period of time, when Moore and Kuntze (1998) evaluated the impact of SFPs on enrollment and attendance in randomly selected communities. The authors found that the SFPs were directly correlated to increases in enrollment and attendance, in addition to lower dropout and repeater rates and higher national exams success rates, especially among girls.

Gelli (2006) analyzed data from 4,175 WFP assisted SFPs in 32 Sub-Saharan African and found a yearly average of 14% increase in enrollment for both girls and boys. In a similar vein, a report by the United Nations (UN) indicates that providing food to children through

THR programs in 32 countries resulted in increased enrollment, especially among primary school girls (Francisco Espejo, Carmen Burbano, & Elena Galliano, 2009).

In a similar study conducted in Zambia by World Food program ((Francisco Espejo et al., 2009), the introduction of SFP resulted in "an increase from 11.1% of total enrolment in 2002 to 20.1% in 2004" among basic school children ((Francisco Espejo et al., 2009). A study conducted in Tanzania by Navuri (2011) also reports that total enrolment among standard-one primary school children increased from 6,562,722 in 2003 to 8,396,925 in 2007; with average enrollment increasing from to 99% in 2010 from 90% in 2004, while the dropout rates reduced from 6% to 3%.

According to Ramadhani (2014) there are several factors that contributes to short-hunger among school children; these include distance travelled by children to school, cultural eating practices – e.g. eating small or no breakfast. The WFP (2004) asserts that short-term hunger caused by 'skipped meals' among school children negatively affects their learning capacity. Briggs (2008) notes that meals provided through SFPs, e.g. small snacks served early in the morning or at mid-morning, are effective in alleviating short-term hunger among school children; and are directly linked to improvements in learning capacity through increased activeness and awareness.

Findings from a study by Ahmed (2004) in Bangladesh indicates that in addition to increases in enrollment and completion rates, SFPs resulted in significant improvement in academic achievements measured by test scores of participating children. Taras (2005) conducted a review of research on the effect of micronutrient supplements provided

through SFPs, and found that providing food supplements, particularly iron, results in improved cognitive performances due to increases in the concentration span and by extension improved learning capacity of school children. Madeley (2000) also reports that, providing food through SFPs results in attention and concentration increases among school children resulting in improved academic performances. King and Burgess (1995) suggest that SFPs results in reduced absenteeism and increased attendance both of which positively affects academic performance.

Zenebe et al. (2018) asserts that the general health status, cognitive performance and educational achievements of school aged children are impacted by their nutritional status. The author notes that inadequate nutrition among school children can lead to diminished cognitive development either through a reduced ability to participate in the learning process or negative physiological changes. The findings of a study conducted by Bundy et al., (2009), suggest that though micronutrient deficiencies can occur at any age, its prevalence is high among school children. King and Burgess (1995) posits that SFPs are effective in improving the nutritional status, in addition to the general health status of participating school children. The authors note that SFPs serves as an avenue to provide food supplements that prevents nutritional deficiencies, particulars anemia, and improve growth and well-being among school children. According to Briggs (2008), SFPs designed to supply micronutrient (e.g. iodine, vitamin A and iron) have been found to greatly improve the micronutrient status of participating school children.

2.5 Nutritional Status and Academic Performance

The correlation between the nutritional status and academic performance of school children has received significant attention in the SFP literature in recent times. Averett and Stifel (2007) studied the impacts of underweight and overweight in school-age children's cognitive function and reports that well-nourished children had higher cognitive skills than malnourished children. In a related study, Alaimo et al. (2001) also found that children aged 6-11 from ' food-insecure ' homes had lower scores on arithmetic testing, had trouble getting along with their colleagues, and were more probable to repeat a grade.

Taras (2005) conducted a review of published studies on the correlation between the nutritional status and academic performance of school-aged children; and reports that children suffering from iron deficiencies at a level that makes them anemic scored low on cognitive functioning tests. Kaestner and Grossman (2009) also report that at the bottom and top of the weight distribution children had lower test results than those at the distribution center. The authors also discovered that children in the weight distribution's lowest tail (0 to 5 percentiles) had test results 4% to 6% reduced than children in the center of the distribution.

In a study by Kleinman et al. (2002) involving US inner city public school children, the author found that “about one third of the children had low caloric intakes and/or low intakes of selected micronutrients” and starvation was more likely to be reported, more psychological issues reported, greater absenteeism levels, and worse grades as compared to well-nourished children.

Hinrichs (2010) undertook a study to explore the contribution of SFPs in improving educational achievements and the health status of school children. According the study, participation in SFP had a lower effect on health in the long-run, but a significant and sizeable effect on educational achievements. The author reposts that health and educational outcomes of SFPs differ across the various grade levels; and that the SFP had a stronger effect on educational achievement among grades 7 through 11 participants than it did for participant in the earlier grades, whereas the results suggested that "participation in earlier grades is more important for the health outcomes."

2.6 The Ghana School Feeding Program

According to Abotsi (2013), the Government of Ghana (GoG) has proved purposeful and progressive commitments through countless measures and policy directives in its pursuit of Universal Primary Education (UPE-MDG 2). The Free Compulsory Universal Basic Education Program and Growth Poverty Reduction Strategy (GPRS) are examples of these measures and policy guidelines. Specific programs such as the Capitation Grant for the abolition of school charges; the expansion of Early Childhood Development facilities; the enhancement of gender parity at main school level; and the introduction of Nutrition and School Feeding programs by the government has been introduced with rapid impacts directed at attaining UPE (Abotsi, 2013). According to an official government document (GoG, 2006) for SFP in Ghana, the Ghana School Feeding Program (GSFP), is an Africa Agricultural Development Pillar 3 initiative designed to reduce hunger and improve food security in line with the Millennium Development Goals (MDGs). The GoG commenced

the implementation of the GSRP in its present form in 2005 with support from the Dutch Government. In implementing of the GSFP, the Ministry of Local Government and Rural Development plays an oversight role, and collaborates with partners such as the Ministry of Education (MoE), the Ministry of Food and Agriculture (MOFA), the Ministry of Health (MoH), the Ghana Education Service (GES), and other Strategic Partners such as the World Food Programme (WFP), the Royal Netherlands Embassy, the Social Enterprise Development Organisation (SEND), the Food and Agriculture Organization (FAO), the School Feeding Initiative Ghana Netherlands (SIGN) and the Netherlands Development Organization (SNV).

According to the GoG (2006), the GSFP's was conceptualized to offer one hot nutritious meal, each school day, cooked from domestically cultivated food crops; in order to attain the three-fold objective of; (1) increasing enrollment, attendance and retention rates, (2) reducing malnutrition and hunger, and to (3) boosting the domestic food production. Abotsi (2013) observes that the GSFP motivates families to send their wards to school. The author further suggested that the GSFP is anticipated to result in improved enrolment, retention and turnout as the literature of the SFP support. According to De Carvalho et al. (2011) the strategy to serve meals prepared from nutritionally adequate local food crops means that up to 80% of the program spending will go into the purchase of local foodstuff and therefore provide markets for farm output and cut down on post-harvest losses, boosting the economies of participating rural communities.

According to Yendaw and Dayour (2015), the GSFP was first implemented on pilot basis in 10 schools selected from the ten regions of Ghana in partnership with New Partnership

for Africa's Development (NEPAD) in 2005; and by August 2006, the program has extended to 200 schools spread across 138 districts with the participation of over 69,000 school children.

2.6.1 GSFP Targeted Communities

The GSFP design to target school children in communities with the following characteristics:

- Districts classified as 'deprived' by the Ghana Growth and Poverty Reduction Strategy (GPRS) Classification
- Directs with lowest wealth levels
- Most food insecure and poorest districts
- Districts with highest dropout rates
- Districts with lowest school attendance rates (and highest absenteeism rates)

2.6.2 GSFP Selection Criteria

Following is the criteria that informs GoG's decision in selecting communities and specific schools to participate in the GSFP;

- the community's willingness to set up basic infrastructure and make meaningful contributions in cash or in kind
- Poverty status based on data from the Ghana Living Standard Survey (GLSS) and the National Development Planning Commission's Poverty Mapping (NDPC)

- the district assembly's commitment, level of interest and readiness toward the implementation and sustainability of the program
- Evidence of intended provision and development of nutrition and health interventions
- Low rates of school enrolment and/or turnout, as well as gender parity rates
- High dropout rates of school
- Low rates of literacy

2.7 Empirical Evidence for the GSFP

Several studies conducted to evaluate the impact of the GSFP at the various schools and communities has shown that, the GSFP has led to significant increases in Net Primary School Attendance Ratio (NPSER) and Gross Primary School Enrolment Ratio (GPSER) and attendance rates among participating school children (Abotsi, 2013). The effect of the GSRP on cognitive improvement among malnourished school children has also been demonstrated in a number of studies (including Levitsky, 2005, Allen and Gillespie, 2001). Sabbi, Amankwah and Boateng (2009) found significant improvements in the academic performance of undernourished school children who participated in a GSRP that provided breakfast or lunch as compared with the performance of children in the control group.

On the contrary, Osei et al. (2009) reports that though the capitation grants in combination with the GSFP chalked significant success in its early days of implementation, their impact on the quality of education in participating communities are not well defined. For example, increases obtained in the rates of enrollment as a result of these interventions unfortunately

leads to extensive pressure on existing facilities at the schools, therefore resulting in adverse implications for effective teaching and learning processes

According to Abotsi (2013) the bulk of empirical evidence that points to improved academic performance among participating school children are unfortunately based on subjective evaluations. Abotsi argues that, though the performance of high school students who were once participants of the GSFP is supposed to reflect an indirect positive impact of the program, there has been no study carried out to evaluate this long-term impact of the GSFP at that level.

2.8 Summary

The reviewed studies demonstrate that the school feeding program has resulted in measurable gains in enrollment, attendance, and health outcomes. SFP studies in Argentina, Burkina Faso, Cambodia, Chile, Jamaica, Kenya, Laos, the Philippines, Senegal, and Sri Lanka have shown improved effects or impacts on SFPs enrollment and child attendance compared to non-participants.

Similar studies have shown relatively consistent positive effects of SFPs on improved net enrollment and attendance in Ghana. Nonetheless, there is a lack of adequate evidence and clarification as to the no effect of SFPs on growth cognition and academic achievement of school-age children receiving intervention compared to non-school-fed children. To contribute to the gap in knowledge why the intervention fails, this work aims to explore the mechanisms by which the intervention exerts the impact of the learning outcome, highlighting the problems that need to be addressed in designing and implementing SFPs.

CHAPTER THREE

METHODS

3.1 Study design and participants

A randomized control cluster designed was adapted for the scale up of the GSF across the 10 regions (Gelli et al., 2016). Baseline data were collected in June 2013 and follow-up in March 2016. A two-stage stratified random sampling design was used to sample 120 schools from the 60 districts that implemented the program. The study district selection criteria were based on national poverty and food insecurity. The household inclusion criteria was restricted to school going age children between 5 and 15 years of age (Gelli et al., 2016).

The first stage of sampling was stratified in 2 intervention districts: HGSF+ and GSFP, in which 60 schools were selected each from the stratum. In the second stage, the intervention arm was stratified by the two intervention groups and it's counterfactual.750 households were then selected respectively from each stratum .Regards to farming households, the following sampling was adopted in both areas: 10 out of the 25 households in the 60 intervention communities were farmer households and 5 out of the 20 households in the 60 control communities were farming households. For non-farming households, children between the age group of 5-15 years were randomly selected (Gelli et al., 2016) .

The distribution of the sample between farming, non-farming households and between project control groups allowed for the construction of comparable samples. Figure 3 depicts the systematic views of the design of selection.

Randomization

The randomization was done at the school and household level. The design involved three arms (Figure 1) identified as:

1. 1.Standard Ghana School Feeding Program (GSFP): These were schools and communities that already implemented the standard GSFP, with caterers responsible for food procurement and preparation.
2. Enhanced GSFP group (HGSF): In addition to a pilot capacity building component including training of community-based organizations and other stakeholders on food procurement, nutrition education, and feedback monitoring, these were schools and communities where traditional GSFP is implemented.
3. Control group: These were schools and households from communities that did not implement the intervention. In these group, the intervention was intentionally delayed without the knowledge of the schools and households.

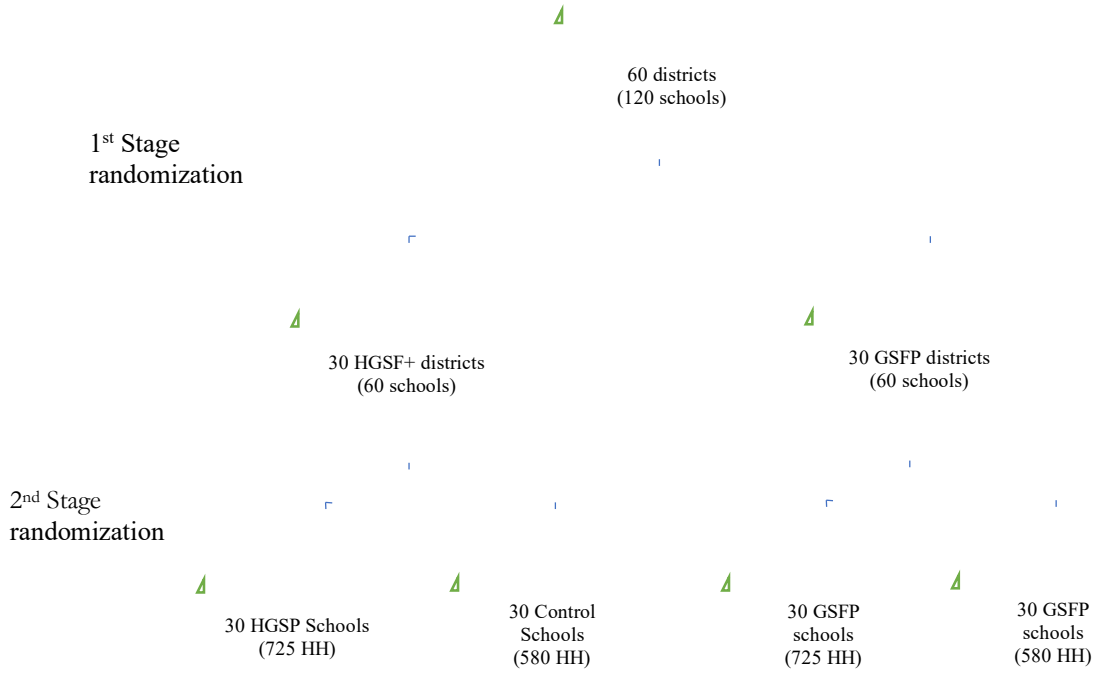

Figure 3:Diagram of the design of the randomization.

3.2 Sample size consideration

The power calculations for impact assessment suggested sampling of 25 households from the communities in the areas of the 60 schools receiving the intervention (SF=GSFP+HGSF+) and 20 households in the 60 control schools communities (Gelli et al., 2016).

The sample population for the study was farm and non-farm households. Farm households' inclusion criteria were households that farmed land sizes varying from 2-5 acres

The following sampling strategy was adopted in both areas: 10 of the 25 households in the 60 intervention communities were farmer households and 5 of the 20 households in the 60

control communities were farmer households. Non-farm households with children in the 5-15 age group were randomly selected from the household listings (Gelli et al., 2019).

The nutritional outcome power calculations were performed using data from the 2008 Demographic and Health Survey (DHS), where the mean ± SD HAZ for rural children < 5 years was −1,03 ± 1,57 and the intracluster correlation coefficient was 0.08 (Figure 4). The results of power calculations suggested the adoption of a sample of 25 households from populations in the catchment regions of the 60 schools receiving the intervention and 20 households in the communities of the 60 control schools, enabling the detection of impact sizes of 0.2 SDs at the end line.

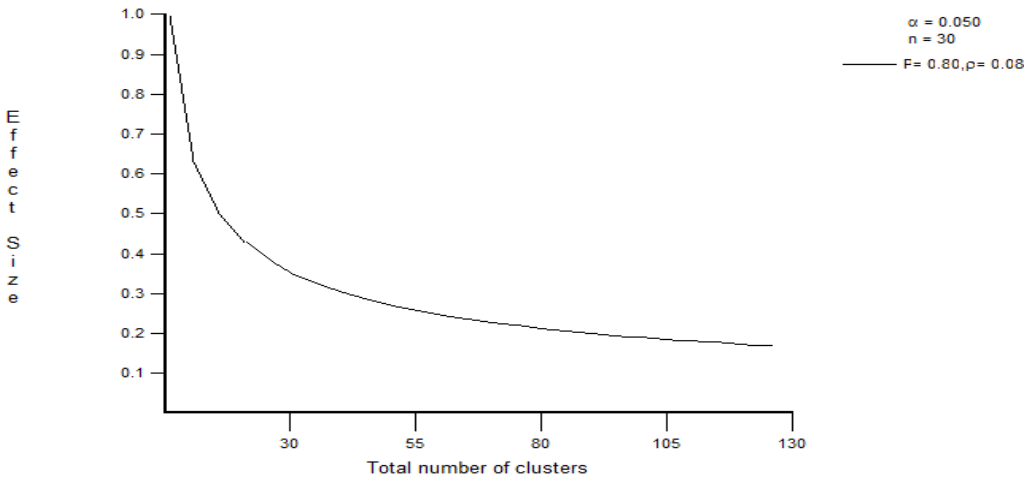

Figure 4: HAZ scores: Minimum detectable difference versus number of clusters

The power calculation on learning outcomes was acquired from data on cognitive testing from a sample of children tested using Raven's matrices in 2003 (Gelli et al., 2016).

The average test score was 15.3 out of 36 questions with a standard deviation of 5.9 and an intracluster correlation factor of 0.14. Figure 5, shows the minimum detectable difference (MDD) compared to the number of clusters.

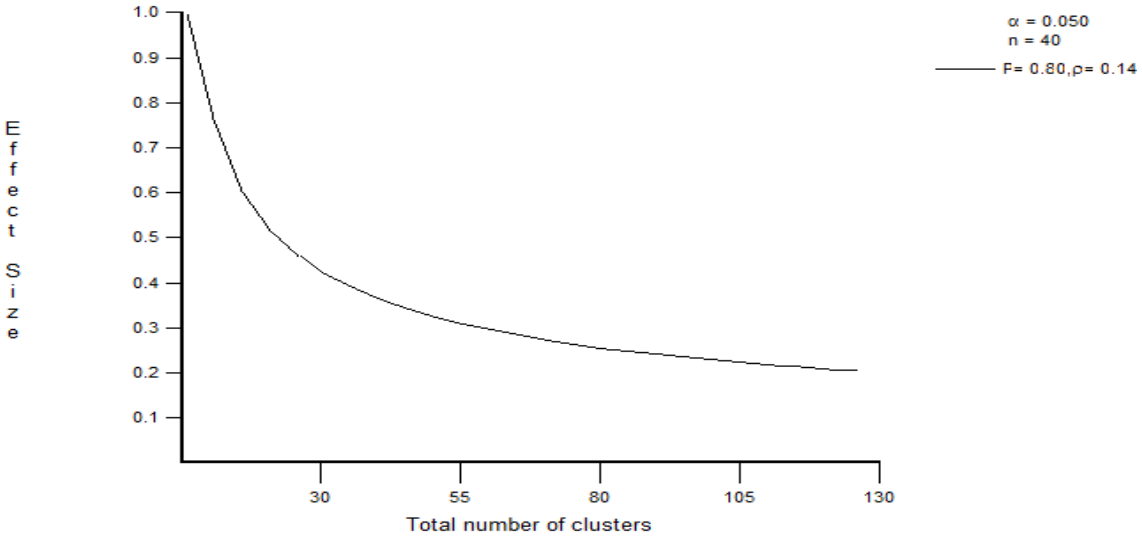

Figure 5: Raven's tests: Minimum detectable difference versus number of clusters

3.3 Data collection and management

In June 2013 and March 2016 respectively, the baseline and end-line surveys were conducted. For both studies, which included household, caterer, and school level, three distinct survey tools were used. The household instrument comprised modules on demographic characteristics, farm assets, financial activity, expenditure, farm income, anthropometry measurements-for all children aged 2-15, micronutrient status, cognitive and literacy testing and mathematics testing.

The caterer questionnaire included modules on the provision of school meal services, the quantities of food provided to students, as well as information on the level of education,

training and supervision received by caterers. Data at the school level included modules for school participation, school water, and health and nutrition education and teachers. The types of data gathered, and the survey tool used are summarized in Table 1.

The survey enumerators were recruited at the baseline and end line respectively by the Noguchi Memorial Institute for Medical Research (NMIMR) and the Institute of Statistical, Social and Economic Research (ISSER). At baseline, mode of interviewing was pen-and-paper (PAPI). Computer-assisted personal interviewing (CAPI) were adapted for the end-line and this was Programmed using CSPro software and data managed by weekly consistency checks. Queries were resolved and updated in the software by supervisors before leaving the field. Standard guidelines were used in taking height and weight measurement. Leicester height measures and electronic remote display version scales were used for the height and weight measurement respectively.

The Noguchi Memorial Institute for Medical Research (NMIMR) and the Institute of Statistical, Social and Economic Research (ISSER) trained enumerators, supervised and managed the data collection process. NMIMR carried out the biomedical aspect of the surveys.

Table 1: Types of information collected and survey instrument

Type of Information	Instrument
Household characteristic including information on demographic composition, level of education of household members, school participation, costs of education, occupation and employment, dwelling characteristics, assets, food and non-food expenditures, farm income, anthropometry measurements (for all children aged 2-15 years), micronutrient status, cognitive and literacy and mathematics achievement test, child dietary behavior and time use, access to other nutrition programs and involvement in the school feeding program.	Household survey
School enrolment, attendance and dropout rates; academic qualification of teachers, water and sanitation, and nutrition and health.	School survey
Cooking environment, meal log, food purchases, nutrition KAP and payment challenges	Caterers survey

3.4 Statistical analysis

To assess whether the randomization has achieved balance of background characteristics between the groups, characteristics were summarized for each group using proportions for categorical variables; mean and standard deviations for continuous variables. The outcome variables in this study are learning outcomes.

The learning outcomes are defined as measures of what a learner has achieved and can reliably demonstrate at the end of a learning process. Different standard items of measurement including literacy test, test of numeracy, and the Raven's progressive test

were used. mixed-effects generalized linear model was used to estimate the effect of HGSFP+ on learning outcomes.

The causal mediation analysis using models of parametric regression was also carried out in Stata with the user-written command Paramed (Emsley and Liu 2013). Paramed covers statistical mediation analysis procedure (Baron and Kenny 1986) that allows for the presence of treatment (exposure)-mediator interactions in the outcome regression model using counterfactual definitions of direct and indirect effects. Paramed estimates two models:

1) a model for the outcome (y) conditional on exposure (a), the mediator (m), and the same covariates (c).
2) a model for the mediator (m) conditional on exposure (a) and any specified covariates (c).

For mode 1 and 2 respectively, log linear and linear regression were fitted. Linear regression model was used for the mediator component to analyze the effect of exposure on the mediator, adjusted by covariates. The model specified as follows:

$$log\{P(Y = 1|a, m, c)\} = \theta_0 + \theta_1 a + \theta_2 m + \theta_3 am + \theta_4{}' c \quad \text{Equation 1}$$

$$linear\{P(M = 1|a, c)\} = \beta_0 + \beta_1 a + \beta_2{}' c \quad \text{Equation 2}$$

Where a = exposure, m = mediator, and c = covariates. Parameters of these two regression models are used to construct estimates of CDE, NDE, NIE, and MTE for the mediator, based on the covariates measured and expressed on the ratio scale.

3.5 Ethical statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of Noguchi Memorial Institute for Medical Research (NMIMR)'s Institutional Review Board (IRB) committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The research used anonymized information from the Ghana School Feeding Program's Impact Evaluation. The Principal Investigators in NMIMR approved permission for the use of data.

CHAPTER FOUR

RESULTS

4.1 Characteristics of participants

In both study rounds, a total of 30 districts were randomized. At the intervention level, twenty-three and twenty-nine schools were randomized: HGSF+ and its control respectively. The HGSF and its counterfactual level surveyed 413 and 444 children aged 5-15 years in both baseline and end-line (Figure 6).

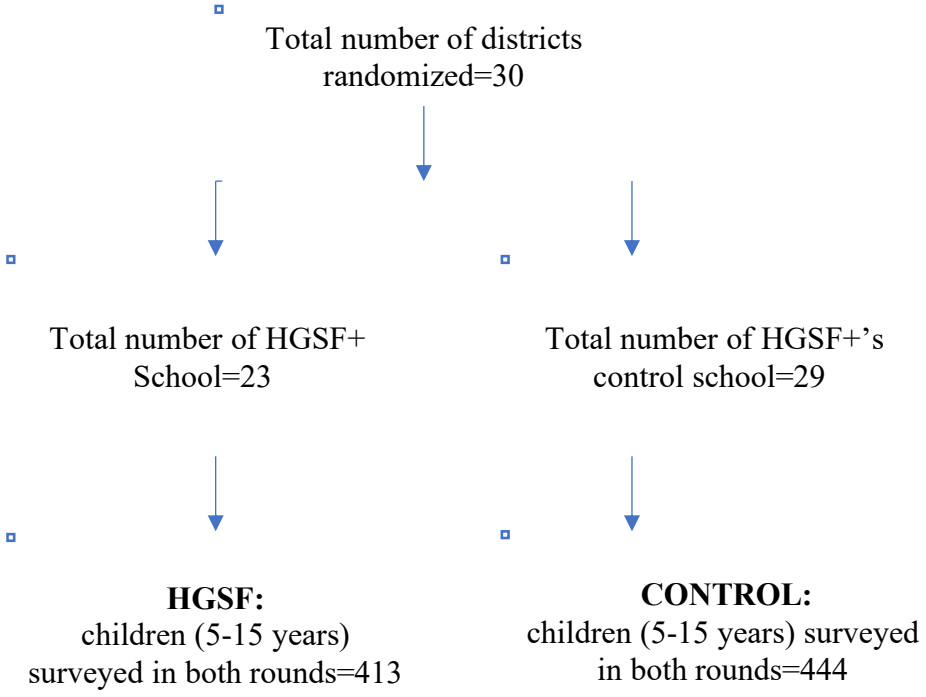

Figure 6:Data flow based on extracted data

Males dominated the sex distribution program. Approximately 55 percent of children were males, and this cut across both HGSF and the control group. The children's average age was 9.8 years. Nearly 60% of the surveyed household had a household size of 5 or more. Table 2 presents the participants ' characteristics by the intervention groups.

Table 2:Characteristics of participants by intervention group (HGSF+ vs control)

Characteristics	HGSF+ n (% of total) n=1,266	Control n (% of total) n=1,409	Total n (% of total) n=2,675
Sex of Child			
Male	668 (52.7)	775 (55.0)	1,443 (53.9)
Female	599 (47.3)	635 (45.0)	1,234 (46.1)
Child's age in years mean (SD).	9.8 (2.8591)	9.7 (2.8)	9.8 (2.8)
Household head's age mean (SD).	46.8 (11.6)	45.7 (12.5)	46.3 (12.1)
Education level of head of household			
No education	203 (40.1)	184 (37.9)	387 (39.1)
Has some Education	303 (59.9)	301 (62.1)	604 (60.9)
Household size			
Small household (<=5)	614 (49.0)	572 (41.0)	1,186 (44.8)
Large household (>5)	638 (51.0)	822 (59.0)	1,460 (55.2)
Zones			
Coastal Savana	38 (3.0)	28 (2.0)	66 (2.5)
Forest	236 (18.6)	237 (16.8)	473 (17.7)
Forest Savana Transitional	263 (20.8)	292 (20.7)	555 (20.7)
Savana	730 (57.6)	852 (60.5)	1,583 (59.1)

4.2 Effect of intervention on learning outcomes

Table 3 shows the effects on student performance of the enhanced school feeding program measured by a standard test. The intervention (HGSF+) generally did show no statistically significant differential effect on learning with respect to the test of literacy and mathematics.

Table 3: Effect of HGSFP+ on learning outcomes (Literacy and Mathematics)

	Mathematics		Literacy		Combined score	
	(1)	(2)	(3)	(4)	(5)	(6)
Estimates	Unadjusted	adjusted*	Unadjusted	adjusted*	unadjusted	adjusted*
Time (2016)	0.828***	0.486***	0.731***	0.387***	0.771***	0.416***
	(0.055)	(0.046)	(0.053)	(0.042)	(0.049)	(0.041)
Treatment (HGSF+)	0.142	0.145*	0.224**	0.215**	0.185*	0.157***
	(0.098)	(0.079)	(0.113)	(0.098)	(0.100)	(0.047)
Impact	-0.041	-0.072	-0.092	-0.112**	-0.065	-0.085
	(0.075)	(0.060)	(0.070)	(0.054)	(0.066)	(0.052)
Constant	-2.047***	-3.155***	-1.938***	-3.255***	-1.982***	-3.229***
	(0.080)	(0.085)	(0.093)	(0.097)	(0.083)	(0.079)
Observations	2,675	2,675	2,675	2,675	2,675	2,675
Number of groups	30	30	30	30	30	30

Standard errors in parentheses.
Sig.: *** p<0.01, ** p<0.05, * p<0.1
* Adjusted for sex and age

4.3 Mechanism of the impact of the intervention

In understanding why, the intervention failed, mediation analysis was conducted using log linear regression and linear regression respectively for the outcome and mediator model. Model 1 in Table 4, reports regression estimates for learning outcomes, except that instead of mathematics and literacy scores, an index score was created as the outcome variable (learning outcome); covariates age and sex were controlled. The association between learning outcome and treatment, micronutrient (HGSF+) was not significant (95% CI -2.25 to1.64, P-value = 0.758). Similarly, the interaction of the mediator and treatment was also not significant (95% CI -0.015 to 0.024, P-value = 0.636).

Model 2 in Table 4, presents the result of the estimates effect of the mediator weight-for-age, conditional on the exposure and the covariates. The model shows, there is no association between the mediator variable weight-for-age and the treatment, micronutrient (HGSF+).

Table 4:Regression models testing relationship between treatment and mediator

Estimate	Model (1) Learning outcome	Model (2) Mediator
	Estimate (95%CI)	Estimate (95%CI)
Treatment (HGSF=1)	-0.30 (-2.245,1.636)	-0.03(-1.748, 1.658)
Mediator (Weight-for-age)	0.01(-.001,0.024)	-
Treatment X Mediator	0.00(-.0149,0.024)	-
Constant	-4.65(-5.871, -3.438)	51/84(47.864,55.824)
Observations	2,675	2,675
Number of groups	30	30

Estimates were adjusted for the effect of age and sex of children.
Model 1: coefficient from linear regression model., Model 2: coefficient from loglinear regression model.

The direct, indirect and total effect of nutrition status weight-for-age are presented in Table 5. After bootstrapping, adjusting for age and sex, the indirect effect of HGSFP+ on learning outcome through the mediator, nutrition status -weight-for-age, was 0.999 (95% CI: (0.972-1.032) and this is statistically significant. This implies that if everyone in the study had the intervention, a geometric mean would increase the outcome score of combined learning outcome by 1 percent. The direct effect of micronutrient showed a geometric mean increase of 26% on learning outcome (95 % CI 0.36 - 1.36) and this is statistically significant.

Table 5: Mediation of the effect of HGSF+ on learning outcomes through nutrition status (weight-for-age) mediator

.	CDE	NDE	NIE	MTE
Mediator	Mean (95%CI)	Mean (95%CI)	Mean (95%CI)	Mean(95%CI)
Treatment (HGSF+)	0.741 (0.378,1.423)	1.180 (1.113,1.256)	0.999 (0.972,1.032)	1.179 (1.108,1.253)

Mean=geometric, controlled direct effects (CDE), natural direct effects (NDE), natural indirect effects (NIE), marginal total effects (MTE)

CHAPTER FIVE

DISCUSSION

5.1 Discussion

As evidenced in the literature, the school feeding program has led to measurable gains in educational and health outcomes. In small, relatively short-term, randomized field control tests, many studies have examined the impact of SFP on learning achievement. Some reported SFP studies in Argentina, Burkina Faso, Cambodia, Chile, Jamaica, Kenya, Laos, the Philippines, Senegal, and Sri Lanka have been statistically significant. In an RCT study conducted in Bangladesh by Ahmed in 2004, among 6 -12 years grade five students, the treatment group were given fortified snacks. The test scores were all estimated using Tobit regressions for English, mathematics and Bengali, and a combined score. Total test results increased in the treatment group by 15.7 percent over control, with mathematics increasing by 28.5 percent and English by 22.2 percent; Bengali scores increased but statistically insignificant.

Other studies that analyzed the impact of SFP on student performance showed the same strong impact or effect as those of Meyers et al. (1989) and Ahmed, 2004. Adrogué and Orlick, (2010) analyzed SFP in Argentina's national public schools; they discovered an effect of the SFP in their non-experimental design on third-grade students ' school scores. Their language scores increased by 0.15 SD, but there was no significant impact on math results.

Improvement in oral eloquence was accomplished in the research of malnourished children in rural Jamaica (Chandler et al.,1995). The investigators studied the short-term impacts on the cognitive performance of eating breakfast, comparing undernourished children with properly nourished children in grades 3 and 4. The children were tested twice as both breakfast and placebo were received. In oral eloquence, they found a significant treatment impact and a significant interaction between the group of nutrients and treatment. Test results for adequately nourished children did not change, while undernourished children performed better at breakfast, suggesting that hunger alleviation may impact cognitive functions. No significant effects have been noted in other cognitive function tests. Finally, Van Stuijvenberg et al. (1999) noticed encouraging average treatment results on digit span cognitive in a year-long randomized intervention that served fortified biscuits for South African children but improved on more dimensions for children with low nutritional status.

The school feeding program intervention was considered in the context of Ghana to address malnutrition and have cognitive effects on children. This study assessed the effect of school feeding on learning outcomes: mathematics and literacy in the context of randomized field experiments conducted among 52 schools in 30 districts where micronutrient was given to the treatment group (HGSFP+) in addition to normal school feeding and control feeding. It was assumed that the impact on learning and test results would be moderate as the quality of the school is unlikely to change in the short term.

Marginal general linear model was used to estimate the effects of SFP on Mathematics. The analysis indicated a decrease in performance by 4.1% in the treatment group over the control group. Similarly, for the Literacy, the test scores decrease by 9.2% in the treatment group over the control. The total score decreased by 6.3%, nonetheless not statistically significant (95% CI: 0.82-1.06, P-value = 0.322). The findings are in line with other studies that also examined the effect of SFP on students' academic performance. Jacoby, Cueto, and Pollitt (1998), in Peru found no impact on mathematics and reading tests among nutritionally at-risk children. Kazianga et al. (2014) also reported no significant impact on cognitive testing in their study in Burkina Faso, with the main positive outcome being that girls took much less time to answer arithmetic questions. Adelman et al. (2008) also concluded that in a randomized intervention in Uganda, there was no impact of school feeding on mathematics or literacy scores. The result is clarified by (Chandler, Walker, & Grantham-McGregor, M.Sally, 1995), that a causal relationship between improving nutritional status and cognitive functions and attention is difficult to infer, as other confounding factors such as low socioeconomic status are likely to influence learning outcomes.

Investigating the mediation effects of the variables is of great importance in providing explanations for the outcomes. The examination of mediator in descriptive studies can clarify why or how a direct association occurs between an independent variable and an outcome variable. To the best of our knowledge, no previous studies have yet examined nutrition weight-for-age as a mediator in the relationship between learning outcome and school feeding program. In this study, mediated model was examined to explore the role

of nutrition- weight-for-age in the relationship between learning outcomes and enhance micronutrient, HGFSP+.

The -paramed- command performs the analysis by fitting a log linear regression model to the outcome, with treatment and the current mediator included as covariates, and then fitting a linear regression model to the mediator including treatment as a covariate. The direct and indirect effects are then calculated by using bootstrap replications. In this analysis, 1,234 replications of the bootstrap were carried out to provide a more accurate estimate of the confidence interval of a non-normally distributed indirect effect and to account for the non-normality of the mediator and the outcome variable (Whittle, Mansell, Jellema, & Windt, 2017).

Initial analysis, revealed the relationship between the treatment level (HGSF+) and the mediator (weight-for-age), was not to be statistically significant (b = -0.04, 95% CI -1.75 - 1.66, Pvalue= 0.959).The final analysis, answering the research question does the mediator not affect the outcome, conducted using the log linear regression of combine learning outcome performance in English and Mathematics score with the treatment level (HGSF+), ignoring the mediator and controlling for age and sex, was also found not significant (b = -0.3, 95% CI -2.25 to1.64, Pvalue= 0.758).The absence of statistically significant mediating impact results to the underpowered test to detect these variable effects (Whittle et al., 2017).

CHAPTER SIX

SUMMARY AND CONCLUSIONS

6.1 Summary of key findings and interpretation

Different evaluations have already established the benefits of the school feeding Program with enhance nutrients, however in Ghana, the study suggested otherwise, hence this study which was driven by these research questions: 1) why did the intervention fail? 2) does the intervention not affect the mediator? 3) does the mediator not affect the outcome? 4) was the direct effect in the opposite direction of the mediated effect?

Mediation analysis was performed in several phases in answering the study questions. First, assessing the direct impacts of the intervention on the mediator-weight-for-age and lastly assessing the mediating impact using the techniques outlined by Valeri and Vanderweele, 2013 to explore the direct and indirect impacts of learning outcomes on nutritional status-weight-for-age.

The initial analysis confirms the relationship between the intervention and the mediator (weight-for-age), was not statistically significant. This suggests, the intervention did not affect the mediator, nutrition- weight- for -age. Nonetheless, the result did not prove that the mediator targeted by the program was incorrect, just that the result was coherent with the null hypothesis of no intervention effect. This could be possibility of delayed program consequences and that program influence on outcome may occur later in time. This support the hypothesis that school quality is unlikely to change in the short term.

The exploration of the relation between the mediator, weight-for-age and learning outcome in response to the research question, does the mediator not affect the outcome, was not statistically significant. Suggesting, a conceptual theory failure as the relation of mediator, weight-for-age to learning outcome is not statistically significant. For example, in a study that does not reject the null hypothesis, the result does not indicate that the program-targeted theory or mediator is incorrect, but that the results are consistent with the null hypothesis of no intervention effects (MacKinnon & Luecken, 2011). The findings, however, raise questions about the theory, intervention strategy, and execution of the program. Due to substitution effects; the age range (5 to 15 years) of the targeted population; and increase in physical activity level of children in the targeted age group, the micronutrient HGSF+ intervention, did not turn out as hypothesized.

This further analysis, answered the question was the direct effect in the opposite direction of the mediated effect. After bootstrapping, adjusting for age and sex, the direct effect of micronutrient, showed a geometric mean increase of 26% on learning outcome (95 % CI 0.36 - 1.36) and this is statistically significant. However, this is not in the opposite direction of the mediated effect.

On the other hand, the indirect effect of HGSFP+ on learning outcome through the mediator, nutrition status- weight-for-age, was 0.999 (95% CI: (0.972-1.032) and this is statistically significant. This implies that if the entire sampled population in the study had

the intervention, the combine learning outcome score would increase on a geometric mean by 1 %.

We interpret the estimated mediation effect of 1% as the expected change in the outcome for a change of HGSFP in the mediator, effect on the mediator, weight-for-age.

6.2 Strength and Limitations of the study

There are some strengths and constraints in this research. One of the main strengths of this research is the use of randomized control design data from a representative nationwide cluster, covering school children aged 5-15 years. Furthermore, the analytical method, mediation analysis, provided a more vigorous test of what could be accountable for a relationship or absence of a relationship between intervention and outcome.

With respect to limitations, anthropometric measurement variables such as height and weight were not properly captured in the baseline. Results were not disaggregated by sex. Finally, the Stata user command -paramed- used in analyzes was unable to adjust to the clustering present in the dataset.

6.3 Conclusions

This study establishes a causal mediation analysis of a piloted Ghana-based improved micronutrient school feeding program that did not have the intended effect on learning outcomes. The pilot intervention project was aimed at improving school children micronutrient level for positive learning outcome.

This study aimed to estimate the effect of school feeding program (SFP) on learning outcomes and determine the mechanism by which the school feeding program impact or otherwise on learning outcome. The study arrived at the results by focusing on these research questions: why did the intervention fail? Does the intervention not affect the mediator? Does the mediator not affect the outcome? and, was the direct effect in the opposite direction of the mediated effect?

The enhanced micronutrient pilot study was conducted in 30 randomized districts, where 23 and 29 schools where randomized into the intervention level: HGSF+ and its control respectively. In the Intervention and control levels, 413 and 444 children in the age of 5 - 15 years were surveyed in both baseline and end line respectively. Robust technique such as multilevel mixed-effects generalized linear model was used to estimate the impact of the intervention on learning outcomes: Literacy and Mathematics, controlling for age and sex of the participant.

In this current study, the result did not show any evidence that the enhanced SFP impacted on learning in regards to Literacy and Mathematics test respectively and this may occur because the intervention was ineffective or by chance. Mediation analysis was performed using a weight-for-age mediating variable to verify that the intervention produced a change in the designed structures. (MacKinnon & Luecken, 2011). The outcomes show lack of a significant in the enhanced micronutrient (HGSF+) to weight-for-age, nutrition status and this implies intervention of providing micronutrient (HGSF+) did not significantly change the weight-for-age mediator, Explanation may be possibility of delayed program effects,

where program impacts may happen later in time on results. This supports the hypothesis that school quality is not likely to change in the short term.

Further analysis shows the relation of the mediator, weight-for-age to the learning outcomes: Mathematics and Literacy was nonsignificant. Conversely, the result raises questions about the program's theory, intervention strategy, and execution. .This explains why the micronutrient HGSF+ intervention did not turn out as hypothesized, because of the increase in physical activity level, substitution effects and the age range (5 to 15 years) of the targeted population .Finally, the direct effect of micronutrient, showed a geometric mean increase of 26 per cent on learning outcome and this is statistically significant. However, this is not in the opposite direction of the mediated effect.

In conclusion, though there was no evidence that the enhanced school feeding program improve learning outcomes, findings of the study suggests design, implementation and timing of the study were causes to the failed desired impact of the enhanced SFP on learning outcomes.

6.4 Recommendation

Below are recommendations, for improvement of the program:

- Duration of the study, should be reconsidered as nutritional/health status indicators takes longer time to track the impact.
- Periodic process evaluation of the program to determine whether program activities have been implemented as intended
- Integration of implementation science outcomes to assess the fidelity, adoption, and uptake is an important consideration for randomized trials.

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