Impact of community nutrition project on malnutrition in children under five: a case of SPRING Ghana project

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Abstract

This study examines the effects of the Strengthening Partnership, Results, and Innovations in Nutrition Globally (SPRING) project on malnutrition (stunting, acute malnutrition, and underweight) among children under five years of age. We employed the Difference-In-Difference (DID) estimation approach and the Ghana Multiple Indicator Cluster Survey data (MICS) to analyze the project's impact. Our analysis showed a strong positive association between the project's effect on the probability of stunting and underweight by 11% (p=0.01) and 9% (p=0.003), respectively, in the treated regions compared with the untreated regions. However, we found no evidence of the project's effect on acute malnutrition. We also provide suggestive evidence that the project may have influenced child nutrition status through antenatal care attendance. This study demonstrated that tackling child nutrition deficiencies through an integrated holistic approach, such as early Antenatal Care (ANC) attendance, increased access to high-quality foods, improving women's nutrition knowledge, and improving agricultural practices, can significantly reduce childhood stunting and underweight.

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Introduction

Childhood malnutrition remains a pervasive public health challenge worldwide, particularly in low and middle-income countries. The World Health Organization (WHO) estimates that approximately 149 million children under the age of five are stunted, 50 million are wasted, and 45 million are underweight globally, reflecting the profound and widespread impact of malnutrition on child health and development.[1] Nutritional deficiencies can compromise the immune system, making it more vulnerable to sickness and diseases, which can become more severe, chronic, and less responsive to treatment. Poor nutrition in early life poses a high risk of physical illness, developmental challenges, and cognitive functioning problems compared with children who have good nutritional needs in their early years.[2-4] Every child is entitled to good nutritional needs, which are necessary for normal growth and development. However, many children in developing countries are unable to meet the nutritional needs required for normal growth. Evidence has shown that a lack of nutrition in childhood has a long-run impact on health status, the labor market, and educational achievement.[5,6] The negative effects are higher for individuals subjected to nutrition deprivation *in utero* or within two years of life.[7]

In light of the concerning magnitude of child malnutrition and its far-reaching effects, community-based nutritional interventions have gained increasing prominence. One such project is the 1,000-day household approach to the Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project introduced in Ghana. In 2014, the SPRING community nutrition project was introduced to reduce malnutrition among children in the two regions of Ghana. The project employs an integrated, holistic approach, such as early Antenatal Care (ANC) attendance, increased access to high-quality foods, improved women's nutrition knowledge, and improved agricultural practices to tackle malnutrition in the two regions.[8,9] Despite the comprehensive nature of the project, to our knowledge, few studies have examined the project's effect on child malnutrition despite its significance.

Although studies have investigated the impact of nutrition projects or program interventions on child health, the results have been inconsistent. For instance, Bhutta *et al*. indicated that nutri-

tion programs alone are not sufficient to reduce stunting or the likelihood of being underweight, but these outcomes can be improved by addressing the determinants of malnutrition, such as poverty and disease burden.[10] A randomized controlled trial conducted in Ghana by Marquis *et al*. evaluated the impact of an integrated agricultural intervention on children's diets and nutritional status. The intervention provided input and training for poultry farming and home gardening, as well as nutrition and health education. The study found that the intervention significantly improved height-for-age and weight-for-age compared with the control group.[11] Kang *et al*. assessed the effectiveness of a community-based nutrition program developed using a positive deviance/hearth approach in rural Ethiopia. The program engaged mothers in 2-week nutrition sessions. The results showed that children in the intervention area had greater increases in height-for-age and weight-for-length than those in the control area.[12] In a study conducted by Linnemayr and Alderman, the effect of a nutrition program aimed at improving child nutrition was evaluated; it was discovered that the program significantly impacted weight-for-age among the youngest children. However, the anticipated efficacy of the prescribed treatment was not fully realized despite its intended impact.[13]

We investigated the effect of the project on malnutrition among children under five years of age by exploiting the natural experimental nature of the project introduction. We hypothesize that the SPRING project will significantly reduce stunting, underweight, and wasting among children less than five years of age. We employed the difference-in-differences approach to comprehensively investigate the effects of the project on child nutrition outcomes. The findings indicate that the policy intervention significantly reduced the probability of stunting and underweight among children under five years of age in the treatment regions, with a reduction of 11% for stunting and 10% for underweight, compared to the control regions. However, the study found no evidence of the project's effect on acute malnutrition. This study contributes to the existing literature on the impact of community nutrition programs on children's health.

Materials and Methods

Project overview

A comparison of anthropometric measurements from the Ghana Demographic and Health Survey (GDHS) showed a decline in stunting from 33% in 1993 to 18% in 2022. Underweight children also declined from 23% to 12% in 1993 to 2022 respectively, and acute malnutrition or wasting decreased from 14% in 1993 to 6% in 2022 (Figure 1).[14] Despite this progress, there are regional variations in under-five malnutrition. For instance, the 2014 Ghana Demographic and Health Survey report revealed that approximately one-third (33%) of children under the age of five in the northern part of Ghana are experiencing stunted growth, which is a significantly higher percentage than the 10% stunting rate observed in the Greater Accra region. Additionally, the prevalence of malnutrition is alarmingly high, reaching 20% among children under 5 years of age in the northern region. While there has been a decline in national stunting rates since 2008, the northern region has seen an unfortunate increase from 32% in 2008 to 33% in 2014.

In response to these concerns, SPRING Ghana introduced a targeted nutrition strategy known as the "1,000-day household approach" in 2014. This approach was designed to focus on specific and critical nutritional behaviors within households, particularly those with pregnant women and children under two years of age, over a span of one thousand days. SPRING relied on evidence-based practices to develop an effective strategy for reducing stunting in the northern and upper-eastern regions of Ghana. Their approach was comprehensive and multi-sectoral, with the aim of addressing various aspects that contribute to malnutrition.[8,9]

The SPRING project emphasized early initiation of breastfeeding, practicing exclusive breastfeeding for six months, and continuing breastfeeding for up to two years. It also focused on providing appropriate complementary feeding, incorporating nutrient-rich options, such as orange-fleshed sweet potatoes. The project provided essential nutrition supplies and conducted a training program for health staff across 280 health facilities, ensuring timely and appropriate care for malnourished children. SPRING also worked with farmers to reduce groundnut exposure to aflatoxins and promoted the growth of nutrient-rich crops, such as vitamin A-enriched maize and orange-fleshed sweet potatoes. Vitamin A maize seeds were supplied to mother-to-mother support groups, and the project collaborated with the Peanut Butter Project to produce safe and nutritious food.[9]

The project advocated the consumption of animal food sources for young children, emphasized clean and safe playgrounds free from human and animal feces, and promoted proper handwashing with soap and the use of latrines. Village savings and loan associations were established in 49 communities to enable them to pool funds for healthcare activities, nutritious foods, and agricultural input. Nutrition counseling services have been introduced in health facilities and at the community level to enhance the quality of infant and young child feeding.[9]

Data source and description

We used the Ghana Multiple Indicator Cluster Survey (MICS) to estimate the effect of the project on malnutrition. MICS is a nationally representative survey that provides detailed information on a wide range of social and economic indicators related to children and women in Ghana. The survey covered a variety of topics, including health, education, child protection, and HIV/AIDS. There were three waves in the dataset: 2006, 2011, and 2017/2018. The article used the 2017/2018 and the 2011 waves for the main results and the 2011 and 2006 waves for the parallel trend. Within each region, sample clusters were allocated between urban and rural areas in proportion to their respective population sizes in the frame. The survey revealed vital information on the health of women and children in Ghana. Women aged 15-49 who perma-

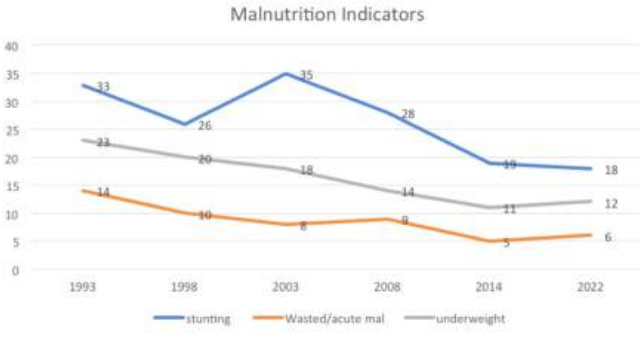

Figure 1. Trends of malnutrition in Ghana.

nently resided in the identified households or visitors who had stayed a night prior to the survey in the identified households were eligible for the interview. Women's questionnaires were used to obtain information on children's health status, including weight and height, which were used to measure children's nutritional status.[15,16] The dataset contained complete information on child height for age, weight for age, and weight for height, which we used to create our dependent variables of interest: stunting, underweight, and acute malnutrition.

Table 1 describes a summary of the statistics of the variables used in the study. It presents the main dependent variables of interest as well as the control variables. The outcomes are low-height-for-age (stunting), low-weight-for-age (underweight), and low-weight-for-height (acute malnutrition), which have a mean percentage of 23.4%, 15.7%, and 7.4%, respectively. There is no wide gender gap in our data set; the mean percentage of males is 50.8%, and females is 49.2%. Most of the respondents are from the poorest and poorer (39.8% and 19.3% respectively) households and rural (62.3%) residents. Most of the mothers in our sample were married (an average of 69.7%), with the majority being between the ages of 35 and 49 (on average, 40.8%).

Estimation design

The SPRING Ghana project was implemented in two regions of Ghana, the Northern and upper-East regions, which operated from 2014 until the end of December 2017. The nature of the project's implementation offers us the opportunity to estimate causal effects. We relied on the quasi-experimental nature of the project implementation to estimate the impact using the difference-in-difference approach. We estimated the program effect using the regions that benefited from the implementation (Upper-East and Northern regions) as treatment regions and the comparison group as the regions that did not receive the program. To avoid confounding effects, we used only two other regions as controls: Greater Accra and Volta. This is because the remaining four regions had similar programs targeting malnutrition reduction during the SPRING project implementation period. We use the following model for our estimation:

$$Y_{ijt}=\beta_0+\beta_1 Treat_j+\beta_2\ Post_t+\delta\ Treat_{ij}*\ Post_t+\beta_3 X'_{ijt}+\ \varepsilon_{ijt}$$

Y_{ijt} represents child health indicators, measured as stunting, acute malnutrition, and underweight. $Treat_{ij}$ takes the value of 1 if regions are the Northern and Upper East regions and 0 if Greater Accra and Volta. $Post_t$ represents 1 if survey year is 2017 and 2018 and 0 if 2011. $Treat_{ij}$ * $Post_t$ is the interaction term between treatment and post. ε measures the program impact. X'_{ijt} represents a vector of independent variables. The independent variables included child age, child gender, mothers' education, age, marital status, household age and education, place of residence, and wealth index. ε_{ijt} represents the error term clustered at the primary sampling unit. The primary sampling unit involved clustering at the household level. The total number of primary sampling units was 300, distributed to urban and rural domains in each region and proportional to

Table 1. Summary statistics.

Variables	n	n	%
Stunting (=1 if height-for-age <-2SD)	64431	15065	(23.4)
Underweight (=1 if weight-for-age <-2SD)	64817	10178	(15.7)
Acute malnutrition (=1 if weight-for-height <-2SD)	64952	4780	(7.4)
Child's gender			
Male	84567	42920	(50.8)
Female	84567	41647	(49.2)
Child's age	84567	84567	-100
Mother's education			
No education	68117	40651	(59.7)
Basic education	68117	24549	-36
Secondary and higher	68117	2917	(4.3)
Residence			
Urban (=1 if mother resides in urban area)	100887	33263	(33.0)
Rural (=1 if mother resides in rural area)	100887	67624	(67.0)
Wealth index			
Poorest (=1 if wealth quintile is poorest)	100076	39813	(39.8)
Poorer (=1 if wealth quintile is poorer)	100076	19279	(19.3)
Middle (=1 if wealth quintile is middle)	100076	15639	(15.6)
Richer (=1 if wealth quintile is richer)	100076	14201	(14.2)
Richest (=1 if wealth quintile is richest)	100076	11144	(11.1)
Mother's age			
15-24 (=1 if mother's age is between 15-24)	92019	14705	(29.5)
25-34 (=1 if mother's age is between 25-34)	92019	12467	(29.7)
35-49 (=1 if mother's age is between 34-49)	92019	12784	(40.8)
Marital status			
Married	92298	64337	(69.7)
Divorced	92298	6534	(7.1)
Never married	92298	21427	(23.2)

Note: the observations for stunting, underweight, and acute malnutrition were lower due to missing observations and non-response. The dependent variables are stunting, underweight, and acute malnutrition, which were measured in z-scores in the Ghana Multiple Indicator Cluster Survey (MIC) dataset using World Health Organization standards.

the size of urban and rural populations in a region. We adjusted the standard errors, allowing for serial correlations within clusters by clustering at the primary sampling level.

Statistical analysis

We used the Ghana multiple indicator survey datasets, 2017/2018 and 2011 with STATA version 17.0 to estimate the project effect on malnutrition using the traditional difference-in-difference approach. We appended the data set, which gives us pseudo-panel data that is useful for the fixed effect difference-difference. The article used the 2017/2018 waves as the post-year and the 2011 wave as the baseline year for the main results. For robustness checks, we estimated parallel trend assumption by creating a pseudo-post, which is a dummy variable that takes the value of 1 if the survey year is 2011 and 0 if the survey year is 2006.

Results

Effect of the project on malnutrition

The estimates of our study on the effects of the community nutrition program on child malnutrition are reported in Table 2. The interaction term Treat*Post measures a project's effect. Models 1 and 2 report the effects of the project on stunting. In Model 1, the project significantly reduced the probability of stunting in treated regions by 11% (p=0.001). In Model 2, we controlled for mother, individual, and household characteristics. Thus, holding all other variables constant, the project significantly reduces the probability of stunting in the treated regions by 11% (p=0.01). Models 3 and 4 report the project's effect on underweight among children under five years of age. In Model 3, the project significantly reduced the probability of underweight among children below five years of age in the project regions by 10% (p<0.001). In Model 4, holding all other covariates constant, the project significantly reduced the probability of underweight by 9% (p=0.003). Models 5 and 6 reported the project effect on acute malnutrition, and the results showed no evidence of the project effect on acute malnutrition.

Because the project reduces stunting and underweight, we further investigated the categories of stunting and underweight that were most impacted by the project. We omitted acute malnutrition because we found no effect of the project on it. The results are presented in Table A.1. In Column 1, the project strongly reduces the probability of severe stunting by 9% (p=0.001), and in Column 2, the policy has no effect on moderate stunting. With underweight in Column 3, the project significantly reduces the probability of severe underweight by 5% (p=0.001), and for moderate underweight in Column 4, we found no evidence of the project effect.

Robustness checks

To ensure that the estimates are valid, we created a variable, pseudo post, equal to 1 if the survey year is 2011 and zero if 2006 to estimate the parallel trend assumption using the equation for the main analysis. Table 3 presents the results of the parallel trend assumption. The interaction term, pseudo-post*treat measures the project effect. The results in all Columns 1-6 are not statistically significant, denoting the existence of a common trend for stunting, underweight, and acute malnutrition in both the treatment and control regions before the introduction of the project.

Heterogenous analysis

The project's effect can differ by locality, and it may be the interest of policymakers to know the categories of people that were most affected by the project to aid in future policy designs. We, therefore, analyze the project effect by place of residence. Supplementary Tables 1 and 2 presents the results of the heterogeneous analysis by place of residence. The project significantly reduces stunting and underweight among children among rural residents by 19% and 13% in Columns 1 and 2, respectively. In Column 3, the results are not statistically significant; the project has no effect on acute malnutrition among rural residents. Columns 4-6 report the project's effect on malnutrition among urban children. The results are not statistically significant among urban children, indicating the project has no effect on urban children.

Mechanisms of project effect

Since we have found a significant positive impact of a project on malnutrition, we have explored the mechanisms through which the project impacts malnutrition. We examined the effects of the project on antenatal care, breastfeeding, and improved toilet facilities. Table 4 presents the results. Column 1 reports the policy effect on antenatal care attendance, thus holding all controls constant, which increases the probability of antenatal care attendance

Table 2. Effect of the project on malnutrition.

Variables	-1 Stunting	p	-2 Stunting	p	-3 Under weight	p	-4 Under weight	p	-5 Acute malnutrition	p	-6 Acute malnutrition	p
Treat	0.21 (0.02)	<0.001	0.14 (0.03)	<0.001	0.17 (0.02)	<0.001	0.14 (0.02)	<0.001	0.02 (0.01)	0.15	0.04. (0.02)	0.043
Post	-0.01 (0.03)	0.75	-0.01 (0.03)	0.72	0.03 (0.02)	0.08	0.04 (0.02)	0.08	0.01 (0.01)	0.61	0.00 (0.02)	0.50
Treat*post	-0.11 (0.03)	0.001	-0.11 (0.04)	0.01	-0.10 (0.03)	<0.001	-0.09. (0.03)	0.003	0.01 (0.02)	0.60	-0.01 (0.02)	0.70
Constant	0.15 (0.02)	<0.001	0.41 (0.20)	0.04	0.08 (0.01)	<0.001	0.33 (0.19)	0.15	0.06 (0.01)	<0.001	0.12 (0.14)	0.19
Covariates	No		Yes		No		Yes		No		Yes	
Observations	33,896		14,107		34,053		14,174		34,236		14,251	
R-squared	0.04		0.07		0.02		0.04		0.00		0.02	

Note: this table reports the main effects of the Strengthening Partnership, Results, and Innovations in Nutrition Globally (SPRING) project on stunting, underweight, and acute malnutrition among children less than five years of age using linear probability model. Post equal 1 if the survey years 2017 and 2018 and 0 if 2011. Treat refers to the Northern and Upper East regions. Treat*post measures the project effect. We control for the following: child's age and gender; mother's age, mother's education dummies, place of residence (rural), and wealth index dummies. The cluster-robust standard errors are reported in parentheses. The error terms were clustered in the primary sampling unit.

by 5% (p=0.016). In Columns 2 and 3, we find no evidence of the project's effect on breastfeeding and improved toilet facilities.

Discussion

The nutritional environment significantly affects brain growth and development. It is crucial to ensure proper brain development through sufficient overall nutrition and a timely supply of essential macro and micronutrients during critical developmental phases. We specifically studied the effect of the community nutrition project implemented by SPRING Ghana on stunting, acute malnutrition, and underweight among children under five years of age using the MICS and the difference-in-difference estimation approach. Thus, our study focuses on the nutritional environment of the fetus and children under five since the project's objective was to improve the health of pregnant women and children. The expectation is that when women consume the essential diet required during pregnancy, children born to those mothers may not experience nutritional disorders.[17] Our results show that the policy significantly reduces the probability of stunting and underweight by 11% and 9%, respectively, among children under 5 years of age in the treatment region. However, we did not find any effect of the project on acute malnutrition. We demonstrate that the results of our analysis are valid through the common trend assumption.

Olney *et al*. demonstrated that providing food-assisted maternal and child health and nutrition programs significantly improves child growth and reduces stunting.[18] This finding is consistent with the results of our study. Kim *et al*. conducted research on an Alive and Thrive Project that implemented extensive behavior change initiatives across four key platforms: interpersonal communication, nutrition-sensitive agricultural activities, community mobilization, and mass media. The study revealed a 5.6% point decrease in stunting,[18] which is in agreement with our findings that the project strongly reduces stunting. Also in line with our findings is the study by Marquis *et al*., a randomized controlled trial in Ghana that evaluates the impact of an integrated agricultural intervention on a child's diet and nutritional status. The intervention provided input and training for poultry farming and home gardening, as well as nutrition and health education. The study found that the intervention significantly improved height-for-age and weight-for-age,[11] which is in unison with our findings. Similarly, Kang *et*

Table 3. Effect of the project on malnutrition.

	-1		-2		-3		-4		-5		-6	
Variables	Stunting	p	Stunting	p	Under weight	p	Under weight	p	Acute malnutrition	p	Acute malnutrition	p
Treat	-0.27	0.15	-0.27	0.09	-0.19	0.21	-0.24	0.20	-0.06	0.64	-0.02	
	(0.19)		(0.19)		(0.15)		(0.17)		(0.13)		(0.02)	
Pseudo-post	0.05	0.90	-0.07	0.77	0.25	0.52	0.19	0.57	0.36	0.35	0.38	
	(0.40)		(0.37)		(0.39)		(0.42)		(0.38)		(0.36)	
Treat*	0.16	0.70	0.19	0.55	-0.23	0.55	-0.18	0.59	-0.19	0. 61	-0.28	
Pseudo-post	(0.40)		(0.37)		(0.39)		(0.42)		(0.38)		(0.36)	
Constant	0.45	0.02	0.61	0.003	0.25	0.10	0.34	0.08	0.14	0. 28	0.10	
	(0.19)		(0.20)		(0.15)		(0.18)		(0.13)		(0.05)	
Covariates	No		Yes		No		Yes		No		Yes	
Observations	17,654		16,096		17,801		16,214		17,774		16,212	
R-squared	0.03		0.05		0.00	0.01		0.02		0.04		

Note: this table reports the main effects of the Strengthening Partnership, Results, and Innovations in Nutrition Globally (SPRING) project on stunting, underweight, and acute malnutrition among children less than five years of age using linear probability model. Post equal 1 if the survey years 2017 and 2018 and 0 if 2011. Treat refers to the Northern and Upper East regions. Treat*post measures the project effect. We control for the following: child's age and gender; mother's age, mother's education dummies, place of residence (rural), and wealth index dummies. The cluster-robust standard errors are reported in parentheses. The error terms were clustered in the primary sampling unit.

Table 4. Channels of project impact.

	-1		-2		-3	
Variables	Antenatal attendance	p	Breastfeeding	p	Improved toilet	p
Treat	-0.03	0.057	-0.06	0.001	-0.24	<0.001
	(0.02)		(0.02)		(0.05)	
Post	-0.002	0.915	-0.18	<0.001	0.02	0.591
	(0.02)		(0.03)		(0.04)	
Treat*post	0.05	0.016	-0.02	0.565	0.001	0.981
	(0.02)		(0.04)		(0.05)	
Constant	0.87	<0.001	1.4	<0.001	0.02	0.928
	(0.15)		(0.23)		(0.21)	
Observations	6,366		6,366		14,437	
R-squared	0.05		0.13		0.26	

Note: this table reports the effects of the Strengthening Partnership, Results, and Innovations in Nutrition Globally (SPRING) project on the channels of malnutrition among children less than five years of age using a linear probability model. Post equal 1 if survey year is 2017/2018 and 0 if 2011. Treat refers to the Northern and Upper East regions. Treat*post measures the project effect. We control for the following: child's age and gender; mother age, education dummies, and place of residence (rural), and wealth index dummies in all the Columns. The error terms were clustered in the primary sampling unit.

al. assessed the effectiveness of a community-based nutrition program developed using a positive deviance/hearth approach in rural Ethiopia. The program engaged mothers in 2-week nutrition sessions. The results showed that children in the intervention area had greater increases in z-scores for length-for-age and weight-for-length than those in the control area.[12]

Haeck and Lefebvre examined the effectiveness of prenatal nutrition programs on child health at birth in Canada. They found that the program led to a significant reduction in low birth weight, which is consistent with our findings.[19] Our findings are consistent with the study by Carlson & Senauer on the special supplemental nutrition program for Women, Infants, and Children (WIC).[20] The study found that the program was much more effective in improving child health than in increasing household income. Overall, these studies provide support for the effectiveness of nutrition programs in improving health outcomes in disadvantaged populations. This is in line with our finding that the rural poor were the most beneficiaries of the project, as presented in Supplementary Table 2.

We also examined the categories of stunting and underweight that were most affected by the project. The results suggest that the project effect on stunting and underweight reduction was more pronounced for severe stunting and severe underweight. We further explored the mechanisms through which the project impacts stunting and underweight. The results of the project strongly increased antenatal care attendance, which is similar to the findings by Bigool *et al*., who showed that the SPRING project increased antenatal care attendance. The results showed that the project's impact on malnutrition was mainly through antenatal care attendance, as shown in Table 4 and supported by prior studies.[8]

We recommend the integration of SPRING Ghana into the Ghana nutrition policy to ensure continuity of the interventions, even after SPRING exits. Other developing countries facing malnutrition challenges should adopt SPRING projects. The government should encourage the local production and distribution of nutrient-rich foods, such as fortified foods, fruits, vegetables, and protein sources, to improve dietary diversity and nutrition among children. Establish systems to provide access to these foods to communities, especially rural communities. We encourage the active participation and ownership of community members in the planning, implementation, and evaluation of nutrition projects. Involving the community ensures that interventions are culturally appropriate, sustainable, and can effectively address local needs. We advocate for evidence-based policies that prioritize child nutrition and health at both the national and local levels. The government should raise awareness about the importance of addressing child malnutrition and mobilize support from policymakers and the public. Policymakers should integrate behavior-change communication strategies that emphasize proper feeding practices, sanitation, and hygiene. Governments and relevant stakeholders should prioritize funding and allocate sufficient resources to support community nutrition projects. Adequate funding is crucial to ensuring the sustainability and effectiveness of interventions aimed at improving child health.

The study has certain limitations that are worth discussing; the MICS dataset was poorly coded, so we could not control most of the independent variables. For instance, Twin birth is coded '1 completed' and '2 not at home', which makes it difficult to understand what it really means. Thus, we could not control for twin birth in our analysis. Although we could not control for some of the covariates, we are certain that our results reflect the true picture of the project impact, since the adjustment of covariates in Table 2 did not alter the magnitude of the policy impact.

Conclusions

The study demonstrated that tackling child nutrition deficiencies through an integrated holistic approach, such as early ANC, increased access to high-quality foods, improving women's nutrition knowledge, and improving agricultural practices, can significantly improve child height for age and weight for height. This study contributes to the existing literature on the impact of community nutrition programs on children's health.

References

1. World Health Organization (WHO). Malnutrition. 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition#:~:text=Globally%20in%202020%2C%20149%20million,age%20are%20linked%20to%20undernutrition
2. Georgieff MK. Long-term brain and behavioral consequences of early iron deficiency. Nutrition Rev 2011;69:S43-8.
3. Neelsen S, Stratmann T. Effects of prenatal and early life malnutrition: evidence from the Greek famine. J Health Econ 2011;30:479-88.
4. Georgieff MK, Brunette KE, Tran PV. Early life nutrition and neural plasticity. Dev Psychopathol 2015;27:411-23.
5. Jamison DT. Child malnutrition and school performance in China. J Develop Econ 1986;20:299-309.
6. Meng X, Qian N. The long term consequences of famine on survivors: evidence from a unique natural experiment using China's great famine. National Bureau Econ Res 2009. Available from: https://www.nber.org/papers/w14917
7. Bryce J, Coitinho D, Darnton-Hill I, et al. Maternal and child undernutrition: effective action at national level. Lancet 2008;371:510-26.
8. Bigool M, Osei Owusu N, Frimpong AA. Effect of healthcare quality initiative on maternal healthcare service utilization: a case study of the SPRING Ghana project. J Public Health Afr 2022;13:2183.
9. Strengthening Partnership, Results, and Innovations in Nutrition Globally (SPRING) . Ghana: Final Country Report. 2018. Available from: https://spring-nutrition.org/publications/reports/ghana-final-country-report
10. Bhutta ZA, Ahmed T, Black RE, et al. What works? Interventions for maternal and child undernutrition and survival. Lancet 2008;371:417-40.
11. Marquis GS, Colecraft EK, Kanlisi R, et al. An agriculture–nutrition intervention improved children's diet and growth in a randomized trial in Ghana. Maternal Child Nutr 2018;14: e12677.
12. Kang Y, Kim S, Sinamo S, Christian P. Effectiveness of a community-based nutrition programme to improve child growth in rural Ethiopia: a cluster randomized trial. Maternal Child Nutr 2017;13:12349.
13. Linnemayr S, Alderman H. Almost random: evaluating a large-scale randomized nutrition program in the presence of crossover. J Develop Econ 2011;96:106-14.
14. Ghana Statistical Service. The DHS Program. Ghana Demographic and Health Survey 2022. 2022. Available from: https://dhsprogram.com/pubs/pdf/PR149/PR149.pdf
15. Ghana Statistical Service Accra, UNICEF. Ghana Multiple Indicator Cluster Survey 2017/18. 2018. Available from:

https://www.unicef.org/ghana/media/576/file/Ghana%20Multiple%20Cluster%20Indicator%20Survey.pdf
17. Olney DK, Leroy J, Bliznashka L, Ruel MT. PROCOMIDA, a food-assisted maternal and child health and nutrition program, reduces child stunting in Guatemala: a cluster-randomized controlled intervention trial. J Nutr 2018;148:1493-505.
18. Kim SS, Nguyen PH, Yohannes Y, et al. Behavior change interventions delivered through interpersonal communication, agricultural activities, community mobilization, and mass media increase complementary feeding practices and reduce child stunting in Ethiopia. J Nutr 2019;149:1470-81.
19. Haeck C, Lefebvre P. A simple recipe: the effect of a prenatal nutrition program on child health at birth. Labour Econ 2016;41:77-89.
20. Carlson A, Senauer B. The impact of the special supplemental nutrition program for women, infants, and children on child health. Am J Agri Economics 2003;85:479-91.