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Effect of a Community-based Primary Healthcare Program on Childhood Morbidity

A Decomposition Analysis

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Research Summary

Why was the research done?

Despite global efforts to improve the health and survival of children under-five years of aged, there are still high proportions of child deaths especially in rural remote settings and developing countries. Community-based primary healthcare programs are widely known to help improve access to and use of maternal and child health services in rural communities. In this study, we examined the contribution of a community-based primary healthcare program called the Ghana Essential Health Interventions Program (GEHIP) to reducing under-five child ill health in a rural setting of northern Ghana.

What were the key findings?

We used data that was collected from mothers before and after the GEHIP intervention from two groups; those communities that received the intervention and communities that did not receive the intervention. Rigorous statistical methods are applied to decipher the improvements in three ill health conditions (illness within the first month after birth, diarrhea and fever) that can be attributed to the community-based intervention. We found that babies in communities in which the intervention was implemented had 15% fewer cases of illness within the first month after birth, 7% less diarrhea and 4% less fever.

What does this mean for policy and practice?

Results of our study implies that GEHIP's community-based primary healthcare program contributed to improving good health of babies in rural remote communities. And since most child deaths often occur because of ill health conditions including diarrhea and fever, we conclude that community-based healthcare programs have a potential for contribute to reducing child mortality in deprived communities and helping to achieve the United Nations Sustainable Development goals on reducing child mortality. We encourage health policy makers and practitioners in rural areas with high child mortality to adopt and implement community-based health strategies as a means to improve healthcare delivery for newborn babies.

Citation

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Effect of a Community-based Primary Healthcare Program on Childhood Morbidity: A Decomposition Analysis

Abstract

Background: Improving child health remains a core objective of global health priorities. Community-based primary healthcare programs are widely acknowledged to hold promise for improving child health, especially in developing countries. This study assesses the effect of a community-based health systems strengthening program known as the Ghana Essential Health Interventions Program (GEHIP) on childhood morbidity in rural northern Ghana.

Methods: Household baseline and end-line survey data of the GEHIP program was used in this study to assess three childhood morbidity conditions; maternal recall of childhood ill-health within the first month after birth, diarrhea, and fever. Oaxaca-Blinder decomposition analysis and the Heckman difference-in-differences are applied to assess the incremental effects of GEHIP exposure on three childhood morbidity conditions: illness within the first month after birth, diarrhea, and fever.

Results: There was generally more reduction in all three morbidity conditions in intervention communities relative to comparison communities. While non-intervention districts observed a significant difference (reduction) in only illness within the first month after birth (Diff=11% p-value=0.001), GEHIP intervention districts observes significant reductions in all three indicators: illness within the first month after birth (Diff=15%, p-value<0.001), diarrhea (Diff=7%, p-value=0.001), and fever (Diff=4%, p-value<0.001). Factors that were significantly associated with childhood morbidity reductions were ethnicity, place of residence, wealth index, and religious affiliation.

Conclusion: Our study shows that GEHIP contributed significantly to childhood morbidity reduction. Confirming that community-based strategies have the potential to improve child health and impact the achievement of the United Nations Sustainable Development goal of improvement in child health.

Keywords: Under-five morbidity, child health, community-based care

Background

Childhood morbidity within the first month after birth, diarrhea, and fever are among the major causes of under-5 mortality [1, 2]. Globally, under-5 mortality declined from 12.7 million deaths to 5.9 million between the 1990s and 2015 [3]. Despite this progress, childhood mortality continues to occur at high rates in developing countries, especially in Africa and Asia. For instance, four out of every five under-5 deaths occur within Sub-Saharan Africa and Southern Asia regions alone [4]. The current United Nations Sustainable Development Goals (SDGs) specifically target reductions in under-5 mortality to 25 per 1000 live births and 12 per 1000 live births for neonatal mortality [4]. However, projections suggest that the SDGs targets are likely not to be achieved by 2030 unless there is a rapid and strategic investment in child survival, particularly in the sub-Saharan Africa region [5]. Thus, critical analyses of available strategies are needed to inform countries striving to achieve the SDG mortality reduction targets [5].

In Ghana, under-five mortality is 52 per 1000 live births [6]. Childhood mortality is disproportionally distributed among the regions of Ghana with Greater Accra region having the lowest rate of 42 deaths per 1000 live births while the Upper West region (Ghana's poorest region) has the highest under-five mortality rate of 78 deaths per 1000 live births [6].

Community-Based Primary Health Programs(CBPHs)

Since the Alma Atta declaration in the 1970s, most low and middle-income countries have adopted community-based primary healthcare strategies as means for delivering low-cost healthcare services to rural poor communities [7–9]. There is substantial evidence that these approaches have led to general improvements in health-seeking behaviour and health outcomes, with associated reductions in maternal and child mortality [10–13]. The impact of delivering primary healthcare through CBHPs has been shown to improve health outcomes, especially for mothers and their children [14–16]. Infant mortality reductions associated with the delivery of primary healthcare through CBHPs average about 40% with some interventions reporting as high as 71% reductions in infant mortality [14].

Moreover, CBHPS has been associated with higher rates of immunization coverage, exclusive breastfeeding, use of oral rehydration therapy, contraceptive knowledge and use, understanding of basic hygiene, knowledge of management of diarrhea in children, and other common diseases [17, 18].

A systematic review found that CBHPs implemented through Lay Health Workers (LHW) in poor community settings could feasibly promote childhood immunization uptake, early initiation of breastfeeding and exclusive breastfeeding [19]. However, this review found that evidence of CBHPs impact on child morbidity and neonatal mortality was of low quality [19]. Also, evidence that CBHPs deployment improved the likelihood of seeking care for childhood illness was of low quality [19]. In conclusion, available evidence indicates that CBHPs reduce morbidity and mortality among children relative to care that is limited to the passive provision of clinical services [19]. There is also a beneficial effect of community-based approaches on the incidence of diarrhea, pneumonia, and undernutrition among the poorest populations [20]. An expert panel conducted a comprehensive review of the evidence regarding the effectiveness of community-based healthcare programs in improving maternal and child health [21, 22]. There is thus strong evidence that the major causes of childhood mortality and morbidity in resourced constraint settings can be addressed at the community level through community-based health programs [21, 22].

Ghana has since the early 2000s adopted community-based healthcare as a key strategy for improving primary healthcare delivery following successful phase trials in northern Ghana [23]. While evidence shows that this approach has contributed to improvements in several health indicators [10,12, 24–26], there is only limited evidence of its effects on childhood morbidity. This study bridges this knowledge gap by assessing the effect of GEHIP's community-based primary healthcare program on under-five childhood morbidity.

Description of GEHIP's Intervention

GEHIP was a six-year health system strengthening program implemented to demonstrate practical means of scaling-up community-based primary healthcare and introducing improvements in the range of services provided by community health workers [27]. GEHIP interventions included training and technical assistance provided to district-level health managers and frontline community health workers. These trainings aimed at building their capacity in both community and stakeholder engagement to support health service delivery and utilization. As a health system strengthening initiative, no new modalities were employed. Instead, the project focused on the challenge of effectively marshalling the system associated with the management of existing staff, equipment, pharmaceutical supplies, and leadership capacity for primary healthcare. Particular focus was directed to improving the implementation of each of the WHO's six pillars of health system functioning [28]. At the onset of the GEHIP,

there was no shortage of nurses for expanding community-based healthcare operations in Ghana; but rather, a lack of health facilities in most communities/villages where trained nurses could be posted to render services [29]. Also limited was district-level leadership understanding of strategies for obtaining resources for constructing and managing community health posts effectively [27].

To address these challenges, GEHIP developed a strategic framework for strengthening community-based primary healthcare. The strategy was focused on improving district-level leadership capacity, use of information for decision-making, logistics, and budgeting, health worker training, and deployment for the provision of healthcare at the community locations. Specific maternal and child health interventions were included within GEHIP, including the integrated management of childhood illness regimen recommended by the WHO [30]. GEHIP also developed a referral service program that enhanced health facility delivery using community engagement strategies to improve social support for referral operations [31]. GEHIP was a plausibility trial [32, 33] in that the introduction of intervention was configured at the district level, preventing the imposition of randomized sampling of observational units. Methods for statistical analysis of non-experimental conditions were therefore required [34]. In the programmatic context of the Ghana Health Services (GHS), region-wide implementation of some interventions involving health worker training and deployment program focused on WHO recommendations for caring for the mother and newborn as well as the integrated management of childhood illness [30, 35]. All such national program interventions were implemented equivalently in treatment and comparison districts.

Methods and Materials

Source of data and Study Setting

Baseline and end-line survey data of GEHIP is used in this study. GEHIP was implemented in a rural and remote region of Ghana to demonstrate practical means of implementing community-based primary health care while strengthening the implementation and interconnectivity of six key building blocks of the health system that WHO had recognized as being critical to any initiative involving systems strengthening [27, 29]. An evaluation of GEHIP showed that it led to about a 48% reduction in neonatal mortality in implemented districts over and above reductions observed in comparison districts [24]. However, the extent to which this community-based health program impacted childhood morbidity is unknown. This study uses household survey data collected from reproductive-aged women at baseline

and end line of GEHIP to answer critical questions on the effectiveness of community-based health programs on improving childhood morbidity.

The GEHIP project was implemented in the Upper East Region (UER), a locality of Ghana that is within the Sahelian savannah ecological belt of north-eastern Ghana. With a population slightly exceeding 1 million [36], the UER ranks among the three poorest and most remote regions of Ghana. Poverty prevalence is 55% and nearly 40% of residents have no formal education [37]. Seven districts in this region were involved in the GEHIP project with three serving as intervention districts and four others serving as non-intervention comparison districts. These districts were purposively selected based on their geographic isolation and socioeconomic deprivation. At the time of implementation, these districts were ranked among the poorest 5% of Ghana's districts with an average per capita income of roughly a quarter of Ghana as a whole [29, 38].

Data collection

Data used in this study was collected through two rounds of household women surveys at baseline and end line for evaluating the childhood morbidity and mortality impact of GEHIP. A two-stage sampling approach was used in which 66 predominantly rural enumeration areas were first drawn and then followed by the sampling of households proportional to population size [24]. In each sampled household, all resident women of reproductive age (15-49) were eligible to be interviewed. The surveys collected data on demographic and socio-economic characteristics of women including their birth histories, access to care, healthcare utilization, and contraceptive use among others. Both study rounds used the same enumeration areas to enhance the statistical efficiency of repeat observation, although no effort was made to reinterview the same women at the end line. A total of 5,604 women from 4,378 households were interviewed at baseline while 5,914 women from 4,421 households were interviewed at the end line. This study uses data of a subset of these sample for women who have had a recent birth thus the baseline included 2,438 women of whom 1,207 were from intervention areas and 1,231 were from comparison districts. The end line sub-sample includes 2,873 women of whom 1,478 were from intervention and 1,395 from comparison districts. Figure 1 shows the study participants from GEHIPS surveys used in this analysis.

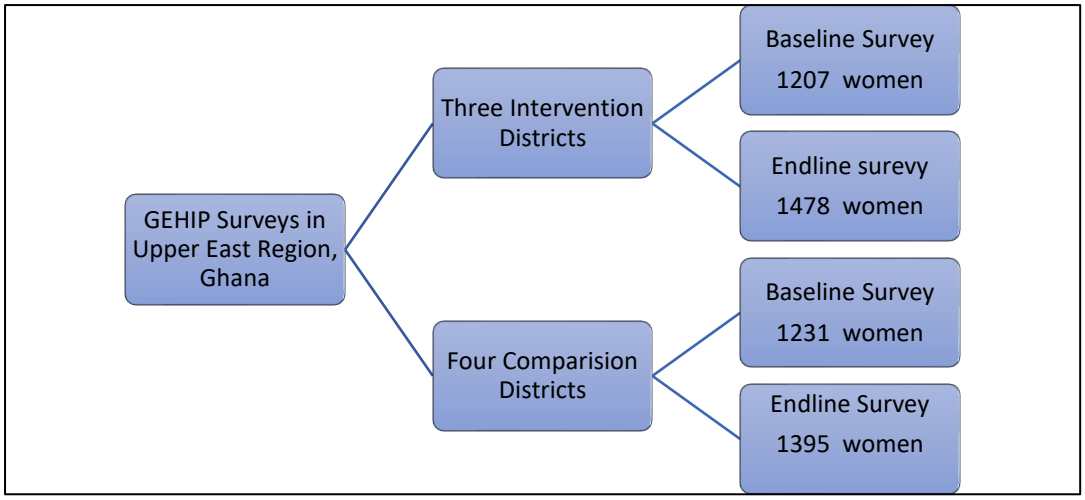


Figure 1: Study Participants from GEHIP Surveys Used in this Study

Outcome Measures

Three childhood morbidity outcome variables have been examined by this study: illness within the first month after birth, diarrhea within the last two weeks and fever within the last two weeks. All three outcome variables were part of the information collected during the household survey from women on their most recent birth below five years of age. A child had an illness within the first month after birth if the mother or primary caregiver responded yes to a question seeking to know if the child was sick within the first 30 days/month after delivery. A child was considered to have diarrhea if the child had three or more watery stools or blood in stools within the last two weeks before the survey. A child was considered to have a fever if the mother or primary caregiver reported that within the last two weeks before the survey the child had a high temperature or shivering for a period that lead to seeking healthcare or administering treatment. Independent variables that have been controlled for in multivariate analysis are mothers' age, education, place of residents, religious affiliation, ethnicity, marital status.

The Oaxaca-Blinder decomposition

The Oaxaca-Blinder decomposition was developed by Blinder (1973) and Oaxaca (1973) and is commonly employed by labor economists to assess the determinants of gap differentials that distinguish between groups of people thereby clarifying sources of inequities [39, 40]. Health economists and epidemiologists have applied this method to research and explain inequalities in health outcomes [41, 42]. Wagstaff et al demonstrate how Oaxaca-Blinder decomposition can be used to decompose the underlying causes of health sector inequalities using child

malnutrition in Vietnam as a case study [41]. The Oaxaca-Blinder procedure decomposes the difference in an outcome variable between two groups into parts: the part due to differences in the distribution of covariates/ determinants between the two groups (known as the endowment effects), the component due to differences in the coefficients of the determinants (known as the coefficient effects), and the component due to interaction between covariates and coefficients (the interaction effect)[43]. If Y represents any of our outcome variables, then the mean difference of the outcome is computed as:

$$D = E(Y_I) - E(Y_C) \ldots\ldots\ldots (1)$$

Here, $E(Y_I)$ and $E(Y_C)$ denotes the expected value of the outcome variable for intervention and comparison groups accounted for by group difference in regressors respectively. The linear model can be written as follows:

$$Y_i = X_i' \beta_i + \varepsilon_i \ldots\ldots\ldots\ldots (2)$$

Where, $E(\varepsilon_i) = 0$ and i € (intervention, comparison), **X** is a vector of predictors, $\boldsymbol{\beta}$ contains the slope parameters and intercepts while $\boldsymbol{\varepsilon_i}$ is the error term. Based on this, the mean difference in the outcome variable can be expressed as the difference in linear prediction at the group-specific means as;

$$D = E(Y_I) - E(Y_C) = E(X_I)' \beta_I - E(X_C)' \beta_C \ldots\ldots\ldots\ldots (3)$$

This is so because,

$$E(Y_i) = E(X_i' \beta_i + \varepsilon_i) = E(X_i' \beta_i) + E(\varepsilon_i) = E(X_i)' \beta_i$$

Where, by assumption $E(\varepsilon_i) = 0$ and $E(\beta_i) = \beta_i$

To further identify the contribution of group differences in the predictors to the overall outcome difference, equation (3) can be rearranged as follows,

$$D = \{E(X_I) - E(X_C)\}' \beta_C + E(X_C)'(\beta_I - \beta_C) + \{E(X_I) - E(X_C)\}'(\beta_I - \beta_C) \ldots\ldots (4)$$

This is also called the "threefold" decomposition. That is the mean difference in the outcome divided into three components represented as

$$R = E + C + I$$

The first components $E = \{E(X_I) - E(X_C)\}' \beta_C$ constitute the difference due to endowment, the second component $C = E(XC)'(\beta I - \beta C)$ measures the contribution of difference due to coefficients sometimes called the discrimination component. The final component I= {E(XI) –

E(XC)}′(βI –βC) is the interaction. It accounts for simultaneous differences in endowments and coefficients between the two groups.

In this study, we perform decompositions for all three outcome variables of interest, first comparing baseline outcomes between intervention and comparison groups, then a comparison of baseline and end line for intervention groups only, and then for comparison group only. The Oaxaca syntax command for implementing Blinder-Oaxaca proposed by Jann (2008) is used in the analysis [44]. STATA version 16 has been used in all the analyses.

Difference-in-differences estimations

To further estimate the impact of GEHIP's community-based health program on childhood morbidity, the Heckman difference-in-differences (DID) is applied to estimate its average treatment effects [34, 45].

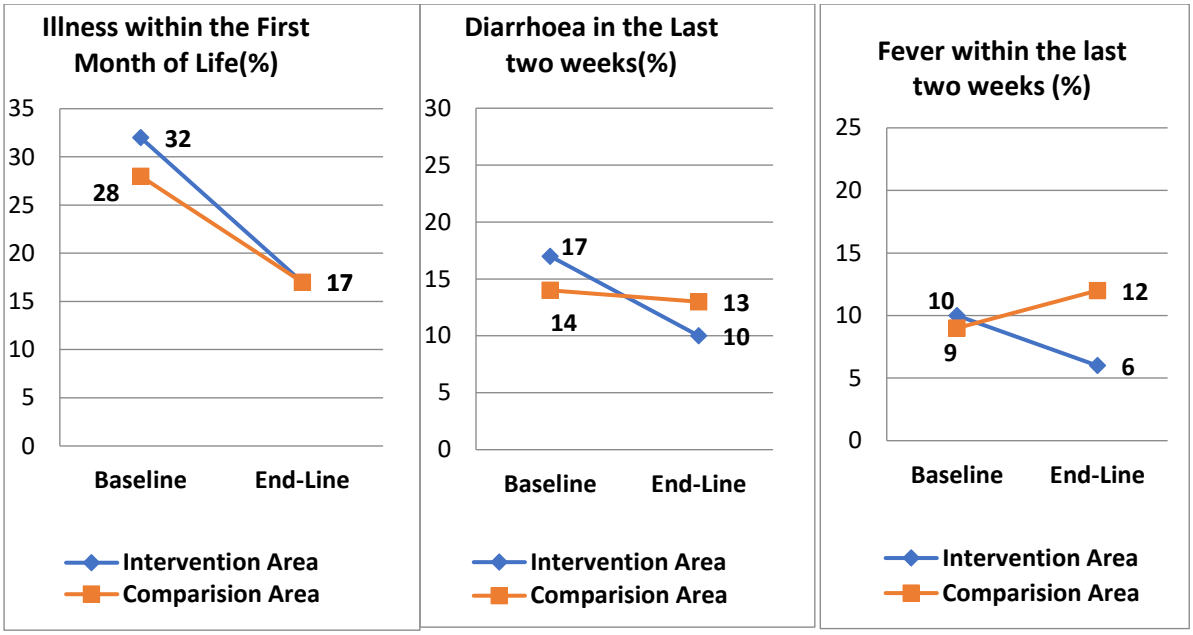
$$\boldsymbol{Outcome_{idt} = \alpha + \gamma GEHIP_d + \theta end_t + \beta(GEHIP_{id} * end_{idt}) + X'_{idt}\rho + \varepsilon_{idt}}$$

Where i represents child, d indicates district (either treatment district or control districts) and t denotes time (either end-line or end line). GEHIP is an indicator that a given child is in the GEHIP intervention district, end is an indicator for end line observation and X denotes a vector of woman/household characteristics that predict child morbidity. Three childhood morbidity conditions are examined in this study- illness within first month after birth, fever and diarrhea as described above. Predictor variables include mother's age, marital status, educational status, household wealth index, religion, ethnicity and parity. ε is the error term. The main parameter of interest is β, our DiD estimator. It measures additional reduction in child morbidity in the GEHIP intervention districts over and above any reduction in the comparison districts that is attributed to GEHIP.

Results

Figure 2 presents the proportion of childhood morbidity incidence by intervention and non-intervention districts for baseline and end line. In general, all three conditions reduced between baseline and end line for intervention districts. In non-intervention districts, illness within the first month after birth and diarrhea in the last two weeks also reduced marginally however the incidence of fever increased by 3% in the non-intervention districts.

Figure 2: Proportion of Under-five Childhood Morbidity



Decomposition Results

Table 1 presents results of decomposition analysis for childhood illness within the first month after birth. Results show no significant difference between intervention and non-intervention districts at baseline. However, there was a significant difference comparing endline and baseline for both intervention and non-intervention districts with intervention districts having a relatively higher reduction compared to non-intervention (Diff= 15% verse 11%). The results further show that none of the differences observed was due to endowments (individual characteristics) but rather the coefficients (discrimination due to treatment effects).

Table 1: Oaxaca- Blinder Decomposition for Illness within the first Month after Birth

Baseline comparision (n=1,776)			Intervention District (n=2,395)			Non-Intervention District (n=2,209)		
	Coef.	Robust Std. Err.		Coef.	Robust Std. Err.		Coef.	Robust Std. Err.
Overall			**Overall**			**Overall**		
Non-intervention	(0.281)	0.030	Basline	(0.321)	0.021	Baseline	(0.282)	0.030
Intervention	(0.320)	0.021	Endline	(0.167)	0.016	Endline	(0.168)	0.013
Difference	(-0.039)	0.036	Difference	(0.154)***	0.026	Difference	(0.114)***	0.032
Endowments	(-0.001)	0.012	Endowments	(0.000)	0.011	Endowments	(-0.003)	0.006
Coefficients	(0.034)	0.040	Coefficients	(0.158)***	0.029	Coefficients	(0.146)***	0.035
Interaction	(-0.073)*	0.036	Interaction	(-0.005)	0.014	Interaction	(-0.030)	0.033
Endowments			**Endowments**			**Endowments**		
Age Group	(0.006)	0.981	Age Group	(-0.000)	0.005	Age Group	(-0.002)	0.003
Marital Status	(-0.021)	2.220	Marital Status	(0.000)	0.000	Matrital Status	(0.001)	0.002
Educational Status	(-0.079)	13.654	Educational Status	(-0.000)	0.005	Educational Status	(-0.002)	0.003
Wealth Index	(0.032)	5.511	Wealth Index	(-0.000)	0.009	Wealth Index	(0.001)	0.002
Religion	(0.100)	17.312	Religion	(0.000)	0.003	Religion	(-0.001)	0.003
Ethnicity	(-0.145)	24.946	Ethnicity	(0.000)	0.004	Ethnicity	(0.002)	0.005
Rural/urban location	(0.073)	12.560	Rural/urban location	(0.000)	0.015	Rural/urban location	(-0.003)	0.004
Parity	(0.026)	4.469	Parity	(0.000)	0.008	Parity	(0.001)	0.003
Coefficients			**Coefficients**			**Coefficients**		
Age Group	(0.213)	0.468	Age Group	(0.089)	0.097	Age Group	(0.116)	0.1304
Marital Status	(0.102)	0.455	Marital Status	(-0.089)	0.127	Matrital Status	(-0.149)	0.1860
Educational Status	(0.077)	0.186	Educational Status	-0.0360	0.070	Educational Status	(0.061)	0.0626
Wealth Index	(-0.020)	0.128	Wealth Index	(-0.049)	0.047	Wealth Index	(0.043)	0.0526
Religion	(-0.202)	0.375	Religion	(0.074)	0.050	Religion	(-0.028)	0.0531
Ethnicity	(-0.624)	1.199	Ethnicity	(0.035)	0.051	Ethnicity	(-0.390)**	0.1324
Rural/urban location	(-0.675)	1.260	Rural/urban location	(0.045)	0.134	Rural/urban location	(-0.055)	0.1292
Parity	(0.049)	0.189	Parity	(-0.087)	0.087	Parity	(-0.080)	0.0798
Constant	(1.115)	2.083	_cons	(0.104)	0.269	Constant	(0.627)*	0.2707
Interaction			**Interaction**			**Interaction**		
Age Group	(-0.001)	0.002	Age Group	(0.001)	0.002	Age Group	(0.005)	0.006
Marital Status	(0.000)	0.002	Marital Status	(-0.001)	0.001	Marital Status	(-0.002)	0.003
Educational Status	(-0.003)	0.005	Educational Status	(-0.002)	0.006	Educational Status	(-0.006)	0.007
Wealth Index	(-0.001)	0.007	Wealth Index	(0.001)	0.003	Wealth Index	(-0.002)	0.003
Religion	(-0.013)	0.010	Religion	(-0.001)	0.005	Religion	(-0.002)	0.005
Ethnicity	(-0.045)	0.029	Ethnicity	(-0.000)	0.003	Ethnicity	(-0.014)	0.028
Rural/urban location	(-0.011)	0.012	Rural/urban location	(0.003)	0.008	Rural/urban location	(-0.003)	0.007
Parity	(-0.000)	0.002	Parity	(-0.006)	0.009	Parity	(-0.005)	0.005
***p-value<0.001, **p-value<0.01, *p-value<0.05								

Table 2 presents decomposition results for the incidence of diarrhea. At baseline (first column of Table 2) although non-intervention districts had a lower incidence of diarrhea, this is not statistically significant. There was also no significant reduction of diarrhea in the non-intervention districts. However, intervention districts observed a statistically significant reduction in the incidence of diarrhea (Diff=7%, p-value <0.001). Again, this reduction was not due to endowments (individual characteristics) but largely due to coefficients (treatment effects).

Table 2: Decomposition Results for Childhood Diarrhea

Baseline Comparision (n=2,314)			Intervention District (n=2,594)			Non-Intervention District (n=2,503)		
	Coef.	Robust Std. Err.		Coef.	Robust Std. Err.		Coef.	Robust Std. Err.
Overall			**Overall**			**Overall**		
Non-intervention	(0.140)	0.013	Basline	(0.174)	0.014	Baseline	(0.140)	0.013
Intervention	(0.174)	0.014	Endline	(0.104)	0.009	Endline	(0.132)	0.015
Difference	(-0.034)	0.019	Difference	(0.070)***	0.017	Difference	(0.008)	0.020
Endowments	(0.003)	0.010	Endowments	(-0.003)	0.005	Endowments	(0.005)	0.008
Coefficients	(0.003)	0.027	Coefficients	(0.084)***	0.019	Coefficients	(0.019)	0.023
Interaction	(-0.040)	0.024	Interaction	(-0.011)	0.010	Interaction	(-0.016)	0.020
Endowments			**Endowments**			**Endowments**		
Age Group	(0.000)	0.000	Age Group	(-0.000)	0.001	Age Group	(0.000)	0.002
Matrital Status	(-0.001)	0.001	Marital Status	(-0.000)	0.001	Matrital Status	(0.000)	0.001
Educational Status	(0.002)	0.004	Educational Status	(0.002)	0.002	Educational Status	(-0.001)	0.002
Wealth Index	(0.002)	0.003	Wealth Index	(-0.001)	0.001	Wealth Index	(0.001)	0.002
Religion	(0.000)	0.002	Religion	(0.000)	0.001	Religion	(0.004)	0.006
Ethnicity	(0.002)	0.005	Ethnicity	(0.000)	0.002	Ethnicity	(0.000)	0.002
Rural/urban locatior	(0.004)	0.003	Rural/urban locatior	(-0.000)	0.002	Rural/urban locatior	(0.004)	0.004
Parity	(0.001)	0.001	Parity	(-0.003)	0.003	Parity	(-0.003)	0.003
Coefficients			**Coefficients**			**Coefficients**		
Age Group	(0.007)	0.079	Age Group	(-0.007)	0.081	Age Group	(-0.093)	0.141
Matrital Status	(-0.021)	0.234	Marital Status	(-0.059)	0.126	Matrital Status	(0.006)	0.133
Educational Status	(-0.006)	0.071	Educational Status	(0.007)	0.050	Educational Status	(-0.018)	0.055
Wealth Index	(-0.004)	0.045	Wealth Index	(-0.006)	0.040	Wealth Index	(0.101)	0.071
Religion	(-0.002)	0.021	Religion	(0.016)	0.033	Religion	(-0.063)	0.071
Ethnicity	(0.042)	0.469	Ethnicity	(-0.010)	0.034	Ethnicity	(-0.309)	0.241
Rural/urban locatior	(-0.024)	0.271	Rural/urban locatior	(-0.108)	0.078	Rural/urban locatior	(-0.153)	0.152
Parity	(-0.006)	0.067	Parity	(0.041)	0.069	Parity	(0.096)	0.099
Constant	(0.017)	0.187	Constant	(0.208)	0.194	Constant	(0.452)	0.348
Interaction			**Interaction**			**Interaction**		
Age Group	(0.000)	0.001	Age Group	(-0.000)	0.001	Age Group	(-0.003)	0.004
Matrital Status	(0.001)	0.002	Marital Status	(-0.001)	0.002	Matrital Status	(0.000)	0.001
Educational Status	(-0.004)	0.005	Educational Status	(-0.001)	0.006	Educational Status	(0.001)	0.004
Wealth Index	(0.002)	0.004	Wealth Index	(0.000)	0.002	Wealth Index	(-0.004)	0.004
Religion	(0.001)	0.007	Religion	(-0.001)	0.003	Religion	(-0.003)	0.005
Ethnicity	(-0.046)	0.029	Ethnicity	(0.000)	0.003	Ethnicity	(-0.007)	0.015
Rural/urban locatior	(0.006)	0.006	Rural/urban locatior	(-0.015)	0.010	Rural/urban locatior	(-0.005)	0.005
Parity	(-0.001)	0.002	Parity	(0.005)	0.011	Parity	(0.004)	0.004

***p-value<0.001, **p-value<0.01, *p-value<0.05

Table 3 also presents results of decomposition analysis for fever. Similar to the other indicators, there was no significant difference in the incidence of fever at baseline. There was a statistically significant difference between baseline and end line of intervention districts in the rate of fever (Diff=4%, p-value<0.01). Similarly, these differences were not influenced by the endowments (individual characteristics) but rather by the coefficients arising from the intervention rather than adjustments associated with the other covariates. The coefficients associated with ethnicity and location of residence were found to be negatively associated with the observed reduction in the incidence of fever in the intervention districts. The constant term was also significantly associated with the reduction which emphasizes the treatment effects of GEHIP on the reduction of fever prevalence.

Table 3: Decomposition Results for Childhood Fever

Baseline Comparision (n=2,386)			Intervention District (n=2,611)			Non-Intervention District (n=2,531)		
	Coef.	Robust Std. Err.		Coef.	Robust Std. Err.		Coef.	Robust Std. Err.
Overall			**Overall**			**Overall**		
Non-intervention	(0.090)	0.010	Baseline	(0.097)	0.009	Baseline	(0.089)	0.010
Intervention	(0.097)	0.009	Endline	(0.059)	0.011	Endline	(0.120)	0.012
Difference	(-0.007)	0.013	Difference	(0.038)*	0.015	Difference	(-0.030)	0.016
Endowments	(-0.000)	0.006	Endowments	(0.002)	0.011	Endowments	(0.000)	0.008
Coefficients	(-0.009)	0.015	Coefficients	(0.048)**	0.015	Coefficients	(-0.029)	0.017
Interaction	(0.002)	0.009	Interaction	(-0.012)	0.013	Interaction	(-0.003)	0.012
Endowments			**Endowments**			**Endowments**		
Age Group	(-0.000)	0.005	Age Group	(0.000)	0.000	Age Group	(-0.001)	0.010
Marital Status	(0.000)	0.005	Marital Status	(0.000)	0.001	Marital Status	(0.000)	0.002
Educational Status	(-0.000)	0.028	Educational Status	(0.000)	0.002	Educational Status	(-0.000)	0.001
Wealth Index	(-0.001)	0.043	Wealth Index	(0.000)	0.001	Wealth Index	(0.000)	0.005
Religion	(0.011)	0.376	Religion	(0.000)	0.000	Religion	(0.001)	0.011
Ethnicity	(-0.001)	0.030	Ethnicity	(-0.001)	0.001	Ethnicity	(0.001)	0.008
Rural/urban location	(-0.009)	0.278	Rural/urban location	(0.002)	0.010	Rural/urban location	(-0.001)	0.008
Parity	(0.000)	0.009	Parity	(0.001)	0.003	Parity	(0.000)	0.001
Coefficients			**Coefficients**			**Coefficients**		
Age Group	(0.025)	0.054	Age Group	(0.011)	0.061	Age Group	(0.090)	0.066
Marital Status	(-0.024)	0.112	Marital Status	(0.075)	0.063	Marital Status	(-0.058)	0.126
Educational Status	(0.005)	0.033	Educational Status	(-0.019)	0.028	Educational Status	(0.009)	0.037
Wealth Index	(0.035)*	0.020	Wealth Index	(0.011)	0.021	Wealth Index	(0.058)	0.032
Religion	(-0.071)**	0.035	Religion	(0.015)	0.019	Religion	(-0.072)*	0.034
Ethnicity	(0.017)	0.043	Ethnicity	(-0.067)**	0.023	Ethnicity	(-0.024)	0.067
Rural/urban location	(0.137)	0.089	Rural/urban location	(-0.150)*	0.060	Rural/urban location	(0.090)	0.066
Parity	(-0.003)	0.042	Parity	(-0.033)	0.032	Parity	(-0.011)	0.048
Constant	(-0.132)	0.148	Constant	(0.204)*	0.086	Constant	(-0.109)	0.161
Interaction			**Interaction**			**Interaction**		
Age Group	(-0.000)	0.001	Age Group	(0.000)	0.001	Age Group	(0.003)	0.004
Marital Status	(-0.000)	0.001	Marital Status	(0.000)	0.001	Marital Status	(-0.001)	0.002
Educational Status	(-0.001)	0.004	Educational Status	(0.002)	0.003	Educational Status	(-0.001)	0.003
Wealth Index	(0.004)	0.007	Wealth Index	(-0.000)	0.001	Wealth Index	(-0.003)	0.004
Religion	(-0.011)	0.021	Religion	(-0.000)	0.002	Religion	(-0.004)	0.009
Ethnicity	(0.004)	0.006	Ethnicity	(0.002)	0.009	Ethnicity	(-0.001)	0.003
Rural/urban location	(0.006)	0.013	Rural/urban location	(-0.013)	0.010	Rural/urban location	(0.004)	0.004
Parity	(0.000)	0.001	Parity	(-0.003)	0.003	Parity	(-0.001)	0.002
***p-value<0.001, **p-value<0.01, *p-value<0.05								

Results of Difference in Difference estimations

Table 4 presents regression results of the difference in differences estimations. The interaction term represents the average treatment effects of GEHIP's intervention. While all the three indicators have a reduction in prevalence as a result of GEHIP's intervention, Diarrhea and fever had a statistically significant effect (OR=0.95, p-value<0.01 and OR= 0.94, p-value<0.001).

Covariate that where significantly associated with treatment effects of childhood illness within the first month after birth are; the mother's educational status and ethnicity. Children born to families belonging to the Kusasi and other ethnic groups were significantly less likely to fall sick within the first month after birth compared with those of Builsa ethnicity.

For the prevalence of diarrhea, the mother's educational status, ethnicity, and parity (number of previous births) were significantly associated with the treatment effects of GEHIP on diarrhea prevalence. Children whose mothers had up to secondary educational attainment and above had 0.95 less odds of having diarrhea compared to those with no formal education (OR=0.95, p-value<0.05). those belonging to the Frafra ethnicity have higher odds of diarrhea compared with the Builsa ethnic group (OR=1.06, p-value<0.01). Also, children of multiparous mothers were less likely to have diarrhea compared with those of primiparous mothers(OR=0.95, p-value<0.05).

Table 4 Results of Difference in Difference estimations

VARIABLES	Illness within the first month after birth		Diarrhea		Fever	
	OR	95% CI	OR	95% CI	OR	95% CI
Treatment *Time	0.98	(0.93 - 1.03)	0.95**	(0.91 - 0.98)	0.94***	(0.91 - 0.97)
Treatment	1.03	(0.99 - 1.08)	1.05**	(1.02 - 1.08)	1.02	(0.99 - 1.04)
Time	0.88***	(0.85 - 0.91)	0.98	(0.96 - 1.01)	1.03*	(1.00 - 1.05)
Age Group (Compared with 15-19yrs)						
20-34	1.02	(0.96 - 1.08)	1.01	(0.96 - 1.06)	1.01	(0.98 - 1.05)
35-49	0.99	(0.92 - 1.06)	0.99	(0.94 - 1.05)	1.01	(0.97 - 1.05)
Marital Status (Compared with Single)						
Married	1.01	(0.97 - 1.06)	0.97	(0.94 - 1.01)	1.00	(0.97 - 1.03)
Educational Status (Compared with No formal education)						
Prim/JHS/Middle Sch	1.03*	(1.00 - 1.06)	0.99	(0.97 - 1.02)	1.01	(0.99 - 1.03)
Sec/Tertiary	1.02	(0.97 - 1.08)	0.95*	(0.91 - 1.00)	1.00	(0.96 - 1.04)
Wealth Index (Compared with Poorest)						
Poor	0.99	(0.95 - 1.02)	1.01	(0.98 - 1.04)	1.00	(0.97 - 1.02)
Better	1.00	(0.97 - 1.04)	0.99	(0.97 - 1.02)	0.97**	(0.94 - 0.99)
Less poor	1.00	(0.97 - 1.04)	1.01	(0.98 - 1.04)	0.99	(0.97 - 1.02)
Least poor	1.00	(0.96 – 1.04)	1.03	(0.99 – 1.06)	0.99	(0.96 – 1.02)
Religion (Compared with Christianity)						
African Traditional Religion	0.98	(0.94 - 1.01)	0.99	(0.96 - 1.02)	0.99	(0.97 - 1.01)
Islam	1.00	(0.97 - 1.03)	1.02	(0.99 - 1.05)	1.02	(1.00 - 1.05)
Ethnicity (Compared with Bulisa)						
Frafra	1.03	(0.99 - 1.07)	1.06**	(1.02 - 1.09)	1.04**	(1.02 - 1.06)
Kusasi	0.93**	(0.89 - 0.97)	1.02	(0.98 - 1.05)	1.04**	(1.01 - 1.07)
Other	0.95*	(0.90 - 0.99)	1.02	(0.98 - 1.06)	1.05**	(1.02 - 1.08)
Location of Residence (Compared with Urban)						
Semi-urban	1.05	(0.98 - 1.11)	0.99	(0.95 - 1.04)	1.04*	(1.00 - 1.07)
Rural	1.02	(0.97 - 1.08)	0.99	(0.95 - 1.03)	1.02	(1.00 - 1.05)
Parity (Compared with one birth)						
2-4 births	1.00	(0.96 - 1.03)	0.96*	(0.94 - 0.99)	1.00	(0.98 - 1.02)
5-7 births	0.99	(0.94 - 1.03)	0.95*	(0.92 - 0.99)	1.01	(0.98 - 1.04)
8 or more births	1.00	(0.93 - 1.08)	0.98	(0.92 - 1.04)	0.99	(0.94 - 1.04)
Constant	1.31***	(1.19 - 1.44)	1.17***	(1.08 - 1.26)	1.02	(0.96 - 1.08)
Observations	4,604		5,097		5,142	

R-squared	0.04		0.01		0.01	

Robust cieform in parentheses
*** p<0.001, ** p<0.01, * p<0.05

For fever prevalence, wealth index, ethnicity and place of residence were significantly associated with the prevalence of fever. Children belonging to the middle wealth quintile (better) are less likely to have fever compared with those of the poorest quintile. Also, those belonging to Frafra, Kusasi, and other ethnicity all have higher odds of having fever compared with those belonging to the Builsa ethnic group. Residents in semi-urban locations also had high odds of fever compared with urban residents (OR=1.04, p-value<0.05)

Diacussion

This study assesses the effect of GEHIP's community-based health program on childhood morbidity in rural northern Ghana. Childhood morbidity contributes to mortality and has high implications on the cost of seeking health care by households as well as the health system cost of treatment. Therefore, understanding the effect of health programs on childhood morbidity is critical for the overall evidence required for improving child health and survival.

This study applied the Oaxaca-Blinder decomposition analysis and the Heckman difference-in-differences procedure to assess the effects of GEHIP exposure on three common childhood mobility conditions: Illness within the first month after birth, diarrhea and fever prevalence. These morbidity conditions are known to be lead contributors to mortality among under-fives globally, especially in low and middle-income countries [46]. Our results show that for all three conditions, children in GEHIP's community-based health program intervention group had more morbidity reduction compared to children in the comparison group. Results from decomposition analysis further confirm that observed differences in the reduction of morbidity conditions are statistically significant in the intervention group over and above those observed in comparison districts. The result also clarifies that these differences are not due to individual characteristics of study participants (endowments) but they are highly due to group differences between intervention and comparison groups.

Difference-in-differences estimates also show significant reduction effects in the prevalence of diarrhea and fever as a result of GEHIP's community-based primary health program. Factors such as mother's education, ethnicity, marital status, and parity were found to be associated with the average treatment effects of the program on childhood morbidity reduction.

Apanga et al using a recent nationally representative data set in Ghana found the prevalence of diarrhea among under-fives to be 17% [47]. This is slightly higher than observed in this study. However, this is not surprising as their results also show that children residing in rural areas had 22% lower odds of diarrhea compared to those in urban areas. Our study is from one of the most rural and remote regions in Ghana with relatively high operations of community-based care facilities in the intervention districts at the end line and considerable level of operation of CHPS is the comparison districts as well.

Factors including mothers educatuion, ethnicity, wealth index and parity were significantly assited with childhood mordity in difference-in difference estinmation. This findings coroburates a previous study from Ghana that also found education and wealth index to be positively associated with lower odds of diarrhea among under-fives [47], our results indicate that when properly implemented, community-based healthcare programs could reduce childhood morbidity irrespective of individual characteristics of the study population.

The fact that two determinants (ethnicity and rural/urban location of residence) were still significantly associated with the observed reductions in fever prevalence may suggests that the impact of community-based health programs on child health could be altered based on different ethnic group and residential locations of implemented communities. As these two variables are markers of the socio-cultural practices and beliefs of communities, it is imperative that the communities-based health programs adapt to the specific nature of communities in order to achieve optimum outcomes.

This study contributes to the evidence-based on the potential of community-based primary healthcare delivery impact on child health improvements as well as reduced cost and stress involved in seeking health care. A recent study found that the average cost of treatment for an episode of fever for households in Ghana is about US$7.3 which is 4.6 times higher than the daily wage associated with unskilled labor and obviously above the average income of most rural dwellers in Ghana [48]. Thus by contributing significantly to reducing childhood morbidity with regards to fever, diarrhea and illness within the first month after birth, community-based programs also reduce the financial burden associated with health-seeking thereby contributing to the socio-economic wellbeing of households in rural poor communities. While the results of this study lead support to the community-based health planning and services program already being implemented in Ghana, it also puts forward compelling reasons for its strengthening and adoption to fit peri-urban and poor communities in the urban settlements of Ghana and similar settings around the world.

Strengths and limitations of the study

This study used "before-and-after" intervention survey data without considering the proximity of individual households to the nearest community health post. The assumption is that a well-functioning program in the context of Ghana's community-based health program facilitates access to community health workers-provided outreach services, thereby offsetting the detrimental effect of household remoteness on coverage and health outcomes. However, this assumption may not always be the case if outreach services are constraint even for the intervention group. Also, a limitation in this study is the fact that CHPS was made a national program in Ghana in the year 2000. Both intervention and comparison districts had some components of CHPS functioning before GEHIP was implemented (about 25% and 35% respectively). By the end of GEHIPs implementation, CHPS covered was about 85% and 55% of the population in intervention and comparison districts respectively. This means the effect of the community-based care may have been underestimated in this study given that both arms of the study had some form of CHPS running. Another limitation of this study as in most studies using survey data is the reliance on retrospective recall data which is prone to recall bias. Older women may be less likely to recall events in the distant past than younger women.

The above notwithstanding, major strengths in this study include its used of data with both intervention and control groups. The use of a rigorous statistical approach such as the Oaxaca-blinder decomposition that provides an opportunity to partial out the group's differences in three-fold enhances the quality of evidence generated by this study.

Conclusion

This study contributes to the evidence-based on the contribution of community-based health programs on child health. The study shows that GEHIP's community-based health program contributed significantly to childhood morbidity reduction, by expanding access to primary healthcare services which mitigates the effects of household remoteness on basic preventive and curative public health care. Our results attest to the potential contribution community-based strategies can make towards improving child health and the achievement of the United Nations Sustainable Development Goal targets of improvement in child health.

The study also demonstrates that the Oaxaca-Blinder decomposition can be applied in evaluating population health programs to better understand program effects on several indicators relevant for policy formulation and practice improvement.

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