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POLICY BRIEF SERIES

# Fragile and Conflict-Affected Food Systems

FCA BRIEF | DECEMBER 2025

## Community Health Worker Caseloads, Home Visits, and Child Survival

Experimental Evidence of Heterogenous Effects from Mali

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### Overview

I examine whether the effectiveness of community health worker (CHW) home visits in reducing under-five mortality varies with the population-to-CHW ratio in rural, fragile, and conflict-affected Mali. Muso, a global health NGO focused on reducing child and maternal mortality, recently signed a data use agreement with IFPRI to enable study of new research questions using data from its recent randomized controlled trial (RCT) of proactive home visits in Mali's Bankass region. The original trial found that proactive home visits by professional CHWs did not lead to detectable reductions in child mortality relative to fixed-site care, although health infrastructure improvements in both treatment arms likely led to experienced large declines in under-five mortality across all study communities amid ongoing conflict.

In this project note, I study heterogeneous effects of the proactive home visit model by population-to-CHW ratios using nearly census level baseline population data and administrative records on CHW assignment. I test the hypothesis that home visits may operate differently when CHWs face particularly high or low caseloads. In theory, CHWs serving small populations may not be necessary for improving access because travel distances to fixed sites are already short, whereas CHWs serving very large populations may be unable to conduct sufficiently frequent and high-quality home visits. If both mechanisms operate, an optimal population-to-CHW ratio may exist.

Instead, I find evidence that CHW home visits are more effective when the population-to-CHW ratio is high. At 900 people per CHW (about the 90th percentile in the trial data), children in control clusters experience significantly higher mortality risk. This elevated risk, however, is offset in clusters assigned to proactive home visits. Additional checks indicate that this is driven by CHW coverage rather than underlying population size. These findings suggest that proactive home visits may be most beneficial in areas where fixed-site CHWs otherwise face heavy caseloads.

## 1. Introduction

Community health workers (CHWs) are central to delivering essential primary health services in low-resource and crisis-affected environments. A substantial body of evidence demonstrates that CHW-led programs can reduce neonatal, infant, and under-five mortality by improving early detection and treatment of common childhood illnesses (Bhandari et al., 2012; Gaye et al., 2020; Whidden et al., 2023). Proactive case detection—regular home visits conducted by CHWs—has been shown in some settings to improve prompt access to care and adherence to preventive practices. Yet evidence on the relative effectiveness of proactive versus fixed-site CHW models, particularly in fragile and conflict-affected settings, remains limited.

Mali represents a prominent case of these challenges. Despite global declines in under-five mortality, Mali continues to experience high mortality levels amid recurrent insecurity, population displacement, and weak health infrastructure. Muso's earlier program in peri-urban Mali demonstrated dramatic reductions in under-five mortality through a proactive community case management model involving proactive home visits, CHW doorstep care, removal of user fees, expanded supervision, and primary care improvements (Johnson et al., 2018). To test the effectiveness of this model in rural settings, Muso and its research partners conducted a three-year randomized controlled trial (RCT) in the conflict-affected Bankass region. The study found that across both arms the under-five mortality rate declined from 148.4 deaths per 1000 live births in the three pre-trial years to 55.1 deaths per 1000 live births over the trial period, but detected no average difference in under-five mortality between proactive home visits and fixed-site CHW services (Liu et al., 2024).

This project note investigates one potential explanation for the absence of an average treatment effect: heterogeneity in impact based on CHW caseloads. Substantial variation existed in the population served by each CHW due to differences between underlying population as well as measurement error in pre-baseline population estimates used for CHW allocation. This variation allows empirical testing of a key hypothesis: whether proactive home visits are more (or less) effective under particular population-to-CHW ratios. Theoretical considerations have ambiguous predictions. In clusters with small populations, fixed-site care may be sufficient because travel distances are short and caseloads manageable. Conversely, in highly populated clusters, CHWs making home visits may be overwhelmed by heavy caseloads, making proactive outreach less effective for identifying untreated childhood illness.

Using nearly census-level baseline household population data and administrative CHW staffing records, I construct population-to-CHW and household-to-CHW ratios for each cluster. I merge these measures with 631,774 child-month observations from the RCT's household surveys. I then estimate heterogeneous treatment effects using Poisson regression models with interaction terms for being above key distributional cutoffs (e.g., 90th percentile) as well as continuous linear and quadratic specifications. Following the original trial specification, all models control for child age, sex, and household distance to the nearest primary health center, with standard errors clustered at the village-cluster level.

Results indicate that CHW home visits are more effective relative to fixed-site service delivery in clusters with relatively high population-to-CHW ratios. Mortality risk is significantly higher in control clusters at the 90th percentile of the ratio distribution (approximately 900 people per CHW), but this elevated risk is offset in treatment clusters receiving proactive home visits. Additional analyses using baseline population alone show no comparable heterogeneity, suggesting that CHW coverage—not population size per se—drives these differential effects. These findings imply that proactive home visits may be most impactful where fixed-site CHWs otherwise face heavy caseloads, providing evidence for CHW deployment strategies that prioritize proactive outreach in understaffed areas.

## 2. Intervention

This study builds on the Proactive Community Case Management (ProCCM) trial implemented by Muso in rural Bankass, Mali and evaluated in Liu et al. (2024). The trial tested an alternative community health workers (CHW) service delivery model of having CHWs administer proactive home visits (treatment) against the status quo model of establishing CHWs at fixed sites in study communities (control).

In both treatment arms, CHWs were professionally trained for one month, salaried, supervised monthly, and equipped to deliver a standardized package of services that adhered to Mali's national community health strategy and provided an identical set of clinical services. These included community-based case management of malaria, pneumonia, and diarrhea; screening and treatment of moderate acute malnutrition; assessment and referral for neonatal danger signs; and referral of pregnant women for antenatal, delivery, and postnatal care. Additionally, prior to launching the trial, extensive system-strengthening measures were implemented uniformly across both study arms. Primary health centers underwent infrastructure upgrades, staffing improvements, and removal of all user fees—a factor known to substantially improve care utilization.

Thus, the key distinction between treatment arms was in how the healthcare was delivered to households rather than a difference in the quality of clinical care itself. Intervention CHWs were tasked with conducting regular proactive home visits, aiming to visit every household at least twice per month. These visits served as a mechanism to identify symptomatic children early, provide doorstep care, and accompany high-risk cases to primary health centers. CHWs in the control arm provided identical services but did so exclusively from fixed sites located in or near their assigned communities.

To evaluate the proactive home visits, the ProCCM trial implemented a two-arm, parallel, unmasked cluster RCT carried out from February 2017 to January 2020. A comprehensive enumeration of all settlements in the study area identified 137 village-clusters, defined as collections of villages or hamlets located within 1 km of each other, across seven catchment areas in the Bankass district. Clusters were randomly assigned to a treatment arm after stratification on distance to primary health center and catchment area.

As noted above, the ProCCM trial documented substantial declines in mortality in both trial arms, despite escalating conflict in the region, likely attributable to the new village-level CHWs and health center upgrades and cost reductions experienced by all study participants. However, the trial did not detect an effect of the proactive home visits deliver mechanism on under-five mortality. Importantly, the evaluation also found no heterogeneity in average treatment effects by cluster population, distance to health facility, or household wealth, but did not test for heterogeneity by CHW caseload.

### 3. Methodology

#### 3.1 Data

The analysis integrates two data sources: (1) the ProCCM household panel surveys, and (2) administrative CHW staffing data from Muso.

First, household panel surveys were administered at four time points: baseline (December 2016–January 2017) and follow-ups at 12, 24, and 36 months. The survey covers nearly all households in the study area, with 98 percent participation at baseline and high recontact rates across rounds. In each survey, female enumerators collected birth histories, child illness histories, care-seeking behavior, and household sociodemographic characteristics using digital tablets. Newly eligible women (aged 15–49) were enrolled at each round, and household rosters were updated to track births, deaths, migrations, and attrition. Birth histories collected at each follow-up provide complete life tables for children from birth until age five or censoring, enabling monthly mortality risk estimation. Across the study period, 31,587 children contributed 52,970 person years of observation.

Second, I also utilize administrative data from Muso on the number of CHWs assigned to a cluster. Prior to the baseline survey, Muso Health used pre-baseline estimates of population in these areas to determine how many CHWs would be assigned to a cluster, targeting a ratio of 700:1 in line with the current policy of the Mali Ministry of Health. Unfortunately, personnel disruptions and security incidents resulted in incomplete records for three clusters, which are excluded from analysis.

#### 3.2 Constructing CHW Ratios

Since all households were eligible and 98% participated, baseline survey data effectively constitute a near-census of the study population. Thus, I calculate baseline cluster population by aggregating all individuals enumerated in the baseline household roster within the cluster. Then, population-to-CHW ratios and household-to-CHW ratios are then defined as cluster’s baseline population and household count divided by the number of CHWs assigned to the cluster, respectively.

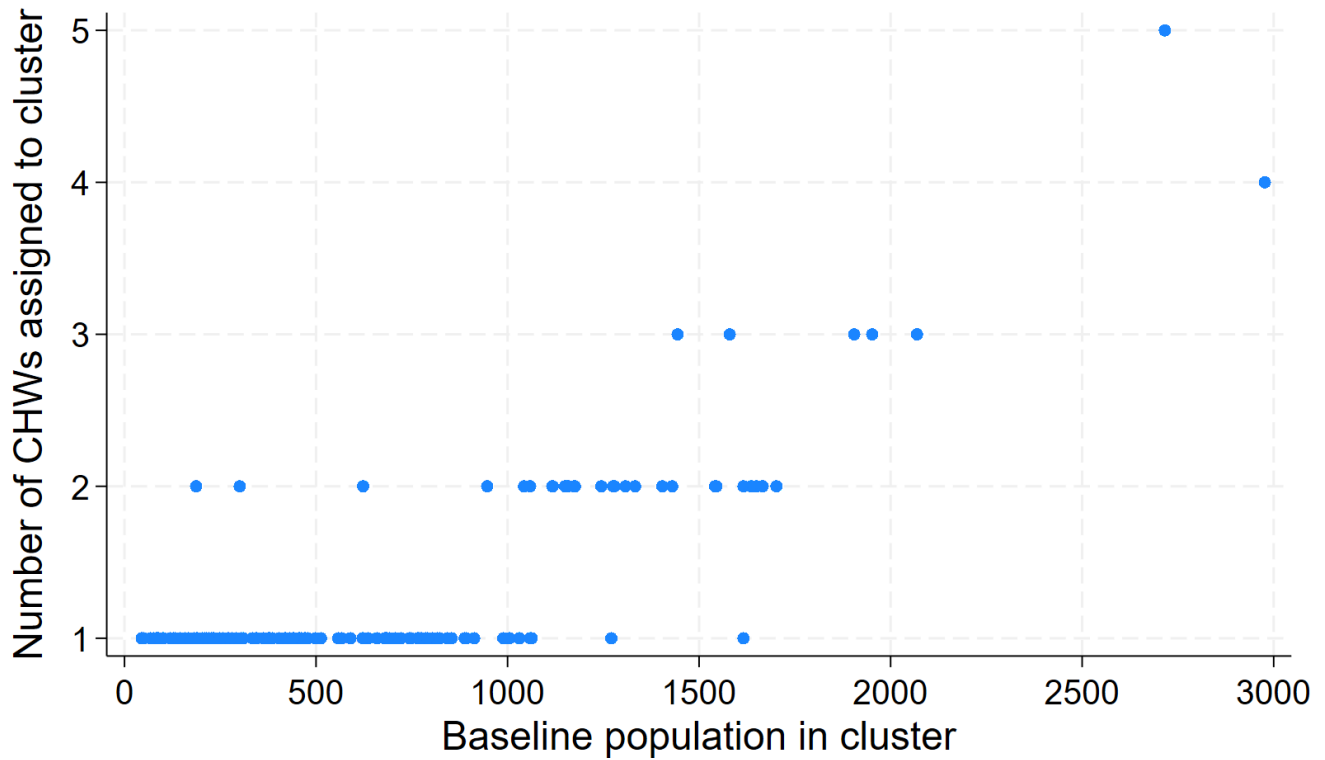
Sample summary statistics of cluster-level baseline population, population-to-CHW ratio and households-to-CHW ratio are provided in Table 1. Cluster-level population averaged 1,137 people but ranged widely from only 380 people at the 10<sup>th</sup> percentile to 1,905 at the 90<sup>th</sup> percentile. However, larger clusters often received multiple CHWs. Thus, cluster population-to-CHW ratios only averaged 667 people per CHW, ranging from 377 people per CHW at the 10<sup>th</sup> percentile to 892 people per CHW at the 90<sup>th</sup> percentile. Finally, cluster household-to-CHW ratios averaged 108 households per CHW, ranging from 61 households per CHW at the 10<sup>th</sup> percentile to 142 households per CHW at the 90<sup>th</sup> percentile. This reveals that some CHW had caseloads nearly 2.5 times larger than other CHWs.

**Table 1:** Summary statistics for measures of cluster’s baseline population, population-to-CHW ratio and households-to-CHW ratio

VARIABLES	Mean	SD	10 <sup>th</sup> ptile	25 <sup>th</sup> ptile	50 <sup>th</sup> ptile	75 <sup>th</sup> ptile	90 <sup>th</sup> ptile
<b>Baseline Population (Pop)</b>	1137.5	662.1	380	684	1059	1545	1905
<b>Population-to-CHW ratio (Pop:CHW)</b>	666.7	248.9	377	529.5	666.5	803	892
<b>Households to CHW ratio (Hhs:CHW)</b>	108.1	38.8	61	89	109	127.25	142

Interestingly, Muso’s CHW assignment decisions were based on pre-baseline population estimates that differed from the actual baseline census. This introduces some additional variation in CHW caseloads: clusters with comparable actual populations sometimes received different numbers of CHWs. Figure 1 shows that the relationship between baseline population and CHW assignment is not a strict step function but exhibits partial overlap. This feature improves the ability to test heterogeneous treatment effects in population-to-CHW ratio since it is not perfectly predicted by differences in baseline population.

**Figure 1:** Distribution of CHWs to baseline population in each cluster



### 3.2 Sample and Outcome Definitions

The sample includes all children under age five during the observation period, generating 631,774 child-months across 134 clusters. The primary outcome is all-cause under-five mortality. Children enter the sample at birth, the start of the trial, or the date they first appear in the household roster. Children are right-censored at age five, death, loss to follow-up, or the end of the trial.

### 3.4 Regression Specification

Following the ProCCM trial, I use a time updated Poisson regression model at the child-month level to estimate the effect of the intervention on the incidence rate ratio (IRR) of under-five mortality:

$$E[Y_{ijm} | ProCCM_j, Cutoff_j, X_{ij}] = \exp(\beta_0 + \beta_1 ProCCM_j + \beta_2 Cutoff_j + \beta_3 (ProCCM_j \times Cutoff_j) + X'_{ij}\gamma)$$

where  $Y_{ijm}$  is an indicator equal to one if the under-five child  $i$  in cluster  $j$  has died in month  $m$ , and zero otherwise;  $ProCCM_j$  is an indicator equal to one if the cluster randomly received the ProCCM proactive home visit intervention, and zero otherwise;  $Cutoff_j$  is an indicator=1 if the cluster is above the listed

Cutoff, and zero otherwise, where I use three different measures to define Cutoffs: 1) cluster's population-to-CHW ratio, 2) cluster's households-to-CHW ratio, and 3) cluster's baseline population; their product  $ProCCM_j \times Cutoff_j$  is the interaction term. Controls  $X_{ij}$  include age group indicators, child's sex and if the nearest primary health center was more than 5 kilometers away.

Additionally, I estimate linear and quadratic heterogeneous effects to test whether the relationship between population-to-CHW ratios and the ProCCM treatment follows a monotonic or nonlinear pattern. A linear interaction assesses whether the marginal effect of treatment steadily increases or decreases as CHW caseloads rise. A quadratic specification allows for the possibility of an interior optimum—where the differential impact of proactive home visits is strongest at a particular ratio and attenuates at both lower and higher levels. To test for linear heterogeneous effects, I interact treatment with continuous measures (represented by  $Z_j$ ) of a cluster's baseline population, the cluster's population-to-CHW ratio or the cluster's households to CHW ratio in separate regression specifications:

$$E[Y_{ij} | ProCCM_j, Z_j, X_{ij}] = \exp(\beta_0 + \beta_1 ProCCM_j + \beta_2 Z_j + \beta_3 (ProCCM_j \times Z_j) + X'_{ij} \boldsymbol{\gamma})$$

To test for quadratic heterogeneous effects, I interact treatment with linear and squared terms of  $Z_j$ :

$$= \exp(\beta_0 + \beta_1 ProCCM_j + \beta_2 Z_j + \beta_3 (ProCCM_j \times Z_j) + \beta_4 Z_j^2 + \beta_5 (ProCCM_j \times Z_j^2) + X'_{ij} \boldsymbol{\gamma})$$

All regressions are estimated with robust standard errors clustered at the village-cluster level to account for correlation among observations at the unit of randomization.

## 4. Findings

Tables 2-5 present the results. Coefficients for all regressions are reported as incidence rate ratios (IRRs) and can be interpreted as the marginal likelihood of under-five child mortality. Thus, coefficients great than one indicate a higher rate of under-five mortality if the indicator=1 relative to if the indicator=0, and vice versa. They also require multiplicative interpretation. For example, the average treatment effect for clusters above a given cutoff equals the product of the main treatment IRR, the cutoff IRR, and the interaction IRR. Tables 2-4 present regressions testing for heterogeneity at six cutoffs defined by 1) cluster's population-to-CHW ratio, 2) cluster's households-to-CHW ratio, and 3) cluster's baseline population, respectively. The six cutoffs were selected to approximately range from the 10<sup>th</sup> to 90<sup>th</sup> percentile of the measure's sample distribution and are evenly spaced within that range. Then, Table 5 presents linear and quadratic heterogeneity results for these three measures as well.

### 4.1 Heterogeneity at Cutoffs

First, Table 2 presents heterogeneity results by the cluster's population-to-CHW ratio, testing effects at a cutoff ranging from 400 to 900 people per CHW. The results find evidence that CHW home visits are more effective than CHWs are fixed sites when the population-to-CHW ratio is relatively high. Specifically, when the population-to-CHW ratio is greater than 900 people to a cluster (approximately the 90th percentile in the sample), under-five children residing in a control clusters exhibit significantly higher mortality risk; IRRs for the *Above Cutoff* indicator exceed 1, indicating elevated mortality risk under fixed-site CHW care. However, the interaction term ( $ProCCM \times Above\ Cutoff$ ) is below 1 and statistically significant, indicating that proactive home visits mitigate the increased mortality risk observed in above-cutoff clusters. When multiplying the *Above Cutoff* IRR of 1.306 by the interaction IRR of 0.722, the combined effect of 0.943 is very close to one, implying that clusters with the proactive home visits

counter the elevated mortality risk associated with relatively high population-to-CHW ratios. I do not find evidence of differential impacts along other cutoffs, including at the ratio of 700:1, which is the currently used as the cutoff for the Mali Ministry of Health and was the ratio that Muso was targeting.

**Table 2: Effects of ProCCM intervention by cluster’s population-to-CHW ratio**

	(1)	(2)	(3)	(4)	(5)	(6)
<b>ProCCM</b>	1.088	1.011	0.988	0.991	1.022	1.049
	(0.207)	(0.135)	(0.0971)	(0.0837)	(0.0865)	(0.0840)
<b>Above Cutoff</b>	1.228	1.014	0.965	0.868	0.880	1.306**
	(0.206)	(0.136)	(0.112)	(0.103)	(0.109)	(0.166)
<b>ProCCM x Above Cutoff</b>	0.937	1.021	1.063	1.065	1.011	0.722*
	(0.196)	(0.167)	(0.152)	(0.168)	(0.173)	(0.133)
<b>Observations</b>	631,774	631,774	631,774	631,774	631,774	631,774
<b>Cutoff per CHW</b>	400 pop	500 pop	600 pop	700 pop	800 pop	900 pop
<b>Share above cutoff</b>	88.7%	78.7%	62.3%	44.0%	25.2%	9.6%
<b>Controls</b>	YES	YES	YES	YES	YES	YES
<b>Control DV Mean</b>	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270

**Notes:** Table reports a Poisson regression of under-five mortality on listed variables with coefficients reported in incidence rate ratios (IRRs). Thus coefficients >1 indicate a higher rate of under-five mortality if the indicator=1 relative to indicator=0, and vice versa. ProCCM is an indicator=1 if the cluster randomly received the ProCCM home visit intervention, and =0 otherwise. Above Cutoff is an indicator=1 if the cluster is above the listed Cutoff per CHW, and =0 otherwise. Their product ProCCM x Above Cutoff is the interaction term. All regressions include controls following Liu et al. (2024). Robust standard errors in parentheses. Significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 3: Effects of ProCCM intervention by cluster’s households-to-CHW ratio**

	(1)	(2)	(3)	(4)	(5)	(6)
<b>ProCCM</b>	1.149	0.941	0.971	1.054	1.077	1.063
	(0.218)	(0.134)	(0.0961)	(0.0959)	(0.0900)	(0.0841)
<b>Above Cutoff</b>	1.249	0.921	0.972	0.951	1.060	1.306**
	(0.216)	(0.128)	(0.111)	(0.111)	(0.153)	(0.166)
<b>ProCCM x Above Cutoff</b>	0.885	1.113	1.085	0.929	0.825	0.664**
	(0.185)	(0.187)	(0.151)	(0.143)	(0.152)	(0.129)
<b>Observations</b>	631,774	631,774	631,774	631,774	631,774	631,774
<b>Cutoff per CHW</b>	65 hhs	80 hhs	95 hhs	110 hhs	125 hhs	140 hhs
<b>Share above cutoff</b>	87.8%	81.7%	67.9%	48.8%	26.1%	10.6%
<b>Controls</b>	YES	YES	YES	YES	YES	YES
<b>Control DV Mean</b>	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270

**Notes:** Table reports a Poisson regression of under-five mortality on listed variables with coefficients reported in incidence rate ratios (IRRs). Thus coefficients >1 indicate a higher rate of under-five mortality if the indicator=1 relative to indicator=0, and vice versa. ProCCM is an indicator=1 if the cluster randomly received the ProCCM home visit intervention, and =0 otherwise. Above Cutoff is an indicator=1 if the cluster is above the listed Cutoff per CHW, and =0 otherwise. Their product ProCCM x Above Cutoff is the interaction term. All regressions include controls following Liu et al. (2024). Robust standard errors in parentheses. Significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Second, Table 3 presents similar evidence while examining cutoffs based on the number of households to CHWs in a cluster, ranging from 65 to 140 households per CHW. Specifically, when the household-to-CHW ratio is 140 (again, approximately the 90th percentile in the sample), under-five children residing in a control cluster have a significantly greater likelihood of mortality, but this negative result is again countered by the proactive home visit intervention.

Next, to confirm that effects are driven by CHW coverage rather than population size, Table 4 presents results testing for differential impacts by a cluster's baseline population, ranging from 400 to 1900 people per cluster. This might confound the previous findings if, for example, the most populated clusters also had the highest population-to-CHW ratios. However, the regressions show no statistically meaningful treatment heterogeneity. This strengthens the interpretation that the number of people or households that a single CHW is expected to serve—not population size in itself—drives differential impacts.

**Table 4:** Effects of ProCCM intervention by cluster's baseline population

	(1)	(2)	(3)	(4)	(5)	(6)
<b>ProCCM</b>	1.239	0.983	1.001	0.955	0.998	1.048
	(0.215)	(0.107)	(0.0990)	(0.0809)	(0.0841)	(0.0851)
<b>Above Cutoff</b>	1.410**	0.895	0.939	0.892	0.898	1.172
	(0.210)	(0.100)	(0.113)	(0.126)	(0.133)	(0.181)
<b>ProCCM x Above Cutoff</b>	0.816	1.066	1.058	1.242	1.111	0.873
	(0.158)	(0.155)	(0.162)	(0.207)	(0.187)	(0.142)
<b>Observations</b>	631,774	631,774	631,774	631,774	631,774	631,774
<b>Absolute cutoff</b>	400 pop	700 pop	1000 pop	1300 pop	1600 pop	1900 pop
<b>Share above cutoff</b>	89.3%	72.8%	54.1%	35.2%	22.4%	12.0%
<b>Controls</b>	YES	YES	YES	YES	YES	YES
<b>Control DV mean</b>	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270

**Notes:** Table reports a Poisson regression of under-five mortality on listed variables with coefficients reported in incidence rate ratios (IRRs). Thus coefficients >1 indicate a higher rate of under-five mortality if the indicator=1 relative to indicator=0, and vice versa. ProCCM is an indicator=1 if the cluster randomly received the ProCCM home visit intervention, and =0 otherwise. Above Cutoff is an indicator=1 if the cluster is above the listed Absolute cutoff, and =0 otherwise. Their product ProCCM x Above Cutoff is the interaction term. All regressions include controls following Liu et al. (2024). Robust standard errors in parentheses. Significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

#### 4.2 Heterogeneous Linear and Quadratic Effects

Table 5 presents tests for linear and quadratic heterogeneous effects interaction with a cluster's baseline population (Pop) in columns (1) and (2), respectively, the cluster's population-to-CHW ratio (Pop:CHW) in columns (3) and (4), respectively, and the cluster's households to CHW ratio (Hhs:CHW) in columns (5) and (6), respectively. Rather than identifying any heterogeneous treatment effects, I estimate quite precise null effects across all of the regressions. In other words, I do not detect a linear or quadratic heterogeneous treatment effect in this sample with these conditions, nor identify a particular maximum (or minimum) at which CHW home visits are most (or least) effective. These results are consistent with Tables 2-4, which only found evidence of heterogeneous results in the top 90th percentile of population- or household-to-CHWs ratio but nothing around cutoffs in the middle of the distributions.

**Table 5:** Effects of ProCCM intervention interacted with linear and quadratic measures of cluster's population-to-CHW ratio, households-to-CHW ratio and baseline population

	(1)	(2)	(3)	(4)	(5)	(6)
<b>ProCCM</b>	1.008	0.891	1.031	1.212	1.097	1.058
	(0.124)	(0.183)	(0.188)	(0.395)	(0.209)	(0.322)
<b>Pop</b>	1.000	1.000				
	(7.33e-05)	(0.000234)				
<b>ProCCM x Pop</b>	1.000	1.000				
	(9.31e-05)	(0.000329)				
<b>Pop^2</b>		1.000				
		(6.30e-08)				
<b>ProCCM x Pop^2</b>		1.000				
		(9.40e-08)				
<b>Pop:CHW</b>			1.000	1.000		
			(0.000250)	(0.00102)		
<b>ProCCM x Pop:CHW</b>			1.000	0.999		
			(0.000277)	(0.00115)		
<b>Pop:CHW^2</b>				1.000		
				(9.30e-07)		
<b>ProCCM x Pop:CHW^2</b>				1.000		
				(9.70e-07)		
<b>Hhs:CHW</b>					1.001	0.998
					(0.00157)	(0.00453)
<b>ProCCM x Hhs:CHW</b>					0.999	1.001
					(0.00176)	(0.00570)
<b>Hhs:CHW^2</b>						1.000
						(2.25e-05)
<b>ProCCM x Hhs:CHW^2</b>						1.000
						(2.54e-05)
<b>Observations</b>	631,774	631,774	631,774	631,774	631,774	631,774
<b>Controls</b>	YES	YES	YES	YES	YES	YES
<b>Control DV Mean</b>	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270

**Notes:** Table reports a Poisson regression of under-five mortality on listed variables with coefficients reported in incidence rate ratios (IRRs). Thus coefficients >1 indicate a higher rate of under-five mortality if the indicator=1 relative to indicator=0, and vice versa. ProCCM is an indicator=1 if the cluster randomly received the ProCCM home visit intervention, and =0 otherwise. Population is a cluster's baseline population (Pop), Pop:CHW is the cluster's population-to-CHW ratio, and Hhs:CHW is the cluster's households to CHW ratio. All regressions include controls following Liu et al. (2024). Robust standard errors in parentheses. Significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

### 4.3 Robustness Checks

All results robust to excluding the two clusters greater than 3 CHWs as well as excluding the ten clusters with greater than 2 CHWs. This ensures that these clusters are not serving as outliers that are driving the results. One exception is that the test for heterogenous effects around the cutoff of a baseline population of 1300 finds significant estimates when the sample excludes the ten clusters with greater than 2 CHWs—specifically, clusters above 1300 people in control sectors seem to have less likelihood of under-five child mortality but this is countered in the home visit treatment. However, these effects are not significant in the sample only excluding the two clusters greater than 3 CHWs or the full sample, nor does it does not persist for higher cutoffs. The robustness results are available upon request.

## 5. Discussion

This project note leverages detailed household-level survey data, administrative CHW staffing records, and time-updated Poisson regression models to examine whether the effectiveness of proactive home visits varies with CHW caseloads in rural, conflict-affected Mali. The RCT design—randomizing clusters to proactive home visits versus fixed-site care—provides a rigorous basis for estimating heterogeneous treatment effects across different population-to-CHW ratios. Results consistently indicate that proactive home visits confer greater mortality reductions in clusters with relatively high population-to-CHW ratios, where fixed-site CHWs appear overstretched. At approximately the 90th percentile of caseloads, control clusters face significantly elevated mortality risk, but this risk is offset in clusters assigned to proactive home visits. No comparable patterns emerge when using population alone, underscoring the role of CHW coverage rather than community size.

These findings have important implications for the design and scaling of CHW programs in fragile and conflict-affected settings. Health systems must make strategic staffing decisions under binding resource constraints, and evidence on optimal CHW deployment remains limited. The results suggest that proactive outreach may be particularly valuable in settings where CHWs face heavy caseloads at fixed sites, highlighting the need for staffing models that explicitly account for variation in population-to-provider ratios. By documenting differential impacts across CHW density thresholds, this analysis provides actionable insights for Ministries of Health, implementing partners, and donors seeking to maximize the survival benefits of CHW investments. In contexts like rural Mali—where insecurity and displacement create persistent barriers to care—targeted deployment of proactive home visits in high-ratio areas may enhance resilience, improve timely access to treatment, and strengthen primary health care delivery. Future work incorporating CHW performance and visit-frequency data will help clarify mechanisms and refine guidance for optimal CHW-to-population ratios in similarly constrained health systems.

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## ACKNOWLEDGMENTS

This work was supported by the donors who fund the CGIAR's Science Program on [Food Frontiers and Security](#) through their contributions to the [CGIAR Trust Fund](#). I also thank Emily Treleaven and Arsène Sandie for the feedback and efforts to set up a data use agreement with IFPRI. Funding for the trial was provided to Muso by the United States Agency for International Development, Development Innovation Lab (grant number 7200AA20FA00020); the CRI Foundation; Grand Challenges Canada (awards 1808-17345 and TTS-200237264); and the Johnson & Johnson Foundation (awards 85442 and 82844). The ProCCM trial was led by Ari Johnson & Kassoum Kayentao (Co-PIs), along with Jenny Liu, Emily Treleaven, Caroline Whidden, Saibou Doumbia, Naimatou Kone, Amadou Beydi Cisse, Aly Diop, Mohamed Berthe, Mahamadou Guindo, Brahim Mamadou Kone, Michael Fay, and Saibou Tembely. The ProCCM Trial Group thanks Djoumé Diakité, Youssouf Keita, Aminata dite Nene Konipo, Seydou Sidibé, Mohamed Bana Traoré, Mahamadou Sogoba, Yacouba Samaké, Lamine Guindo, Idrissa Kamara, Mohamed Sylla, Matt Britton, Jane Yang, Boni Ale, Belco Poudiougou, Sergio Bautista Arredondo, David Boettiger, Rakesh Ghosh, Nancy Padian, Tracy Lin, Calvin Chiu, Faith Cole, Sasha Rozenshteyn, Hailey Zuverink, Emily Richard and partners at Medic Mobile, IC4D, Mass Design Group and the national, regional, and district health offices of the Malian government. Finally, we thank the community health workers and their supervisors in the trial area. This work has not been independently peer reviewed. The author used a generative AI tool as an editorial aid during manuscript preparation, primarily to improve clarity, coherence, and concision of the written text. The AI was not used to generate original research content, including data or analysis. All content was carefully reviewed and revised by the author, who retains full responsibility for the accuracy and integrity of the publication. Any opinions expressed here belong to the author and are not necessarily representative of or endorsed by IFPRI or CGIAR. Address for correspondence: James Allen IV, [j.allen@cgiar.org](mailto:j.allen@cgiar.org)

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## REFERENCES

- Bhandari, Nita, Sarmila Mazumder, Sunita Taneja, Halvor Sommerfelt, and Tor A. Strand. "Effect of implementation of Integrated Management of Neonatal and Childhood Illness (IMNCI) programme on neonatal and infant mortality: cluster randomised controlled trial." *Bmj* 344 (2012).
- Gaye, Seynabou, Janelle Kibler, Jean Louis Ndiaye, Mame Birame Diouf, Annë Linn, Alioune Badara Gueye, Fatou Ba Fall et al. "Proactive community case management in Senegal 2014–2016: a case study in maximizing the impact of community case management of malaria." *Malaria Journal* 19, no. 1 (2020): 166.
- Johnson, Ari D., Oumar Thiero, Caroline Whidden, Belco Poudiougou, Djoumé Diakité, Fousséni Traoré, Salif Samaké, Diakalia Koné, Ibrahim Cissé, and Kassoum Kayentao. "Proactive community case management and child survival in periurban Mali." *BMJ Global Health* 3, no. 2 (2018).
- Liu, Jenny, Emily Treleaven, Caroline Whidden, Saibou Doumbia, Naimatou Kone, Amadou Beydi Cisse, Aly Diop et al. "Home visits versus fixed-site care by community health workers and child survival: a cluster-randomized trial, Mali." *Bulletin of the World Health Organization* 102, no. 9 (2024): 639.
- Whidden, Caroline, Kassoum Kayentao, Naimatou Koné, Jenny Liu, Mohamed Bana Traoré, Djoumé Diakité, Mama Coumaré et al. "Effects of proactive vs fixed community health care delivery on child health and access to care: a cluster randomised trial secondary endpoint analysis." *Journal of global health* 13 (2023): 04047.
- Whidden, Caroline, Emily Treleaven, Jenny Liu, Nancy Padian, Belco Poudiougou, Sergio Bautista-Arredondo, Michael P. Fay et al. "Proactive community case management and child survival: protocol for a cluster randomised controlled trial." *BMJ open* 9, no. 8 (2019): e027487.

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