Evaluation of a community intervention to increase recognition of alarm signs in children under 5 in low-income and indigenous communities in the state of Yucatan, Mexico.

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Public Health

University of Washington

2021

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Program Authorized to Offer Degree:

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Abstract

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Improving child health and reducing child mortality is a universal objective, and access and quality of care are two critical elements in the reduction of child deaths. A collaborative study by the Institute of Health Metrics and Evaluation and the University of Yucatan developed a community intervention in low-income and indigenous communities in the State of Yucatan, Mexico, to increase awareness and knowledge surrounding recognizing alarm signs in children under five hence leading to a timelier seeking of care. Initial analysis showed the intervention effect to be positive but not significant in the whole study population. This thesis project investigates whether there was a differential impact of the intervention on alarm sign recognition when stratified by education and household size. The intervention team recruited fifty women each from eight communities (N= 307 participants in total) to participate in the study. Participants filled out questionnaires evaluating alarm sign knowledge for the following health conditions: general medical attention, sepsis, respiratory infections (pneumonia), and congenital heart defects. The intervention was evaluated using an experimental design with pre-and post-intervention data in both the intervention and comparison groups. As the intervention was randomized, the data collected was analyzed as a pretest-posttest study design. Additionally, it

was analyzed using a difference-in-difference approach with the data collected pre- and post-intervention. Results from this analysis show an improvement in knowledge among caregivers of children under five between baseline and follow-up measurements. Though the intervention did not have an effect overall, it did increase recognition of heart defect alarm signs and general alarm signs among caregivers with low education and large household sizes. This intervention program showed a community intervention is able to increase recognition of alarm signs for children under five, especially among caregivers with less education and living in large households.

Introduction

Improving child health and reducing child mortality are universal objectives. Access and quality of care are two critical elements in the reduction of child deaths [1]. Newborn and infant deaths represent 50% of all deaths in children younger than five globally[3]. Timely and high-quality antenatal and child care could avoid an estimated 60% of these deaths[4].

Since 2000, Mexico has focused its health policy goals on bridging the prevalent disparities in access to healthcare, providing quality care, and financial protection against health expenditures to all age groups[5]. Mexico has successfully reduced its under-five child mortality rate by 62% from 41.2 deaths per 1000 live births in 1990 to 15.7 deaths per 1000 live births in 2017[6]. This number remains below the average for Latin America and the Caribbean region. These improvements are on track with Sustainable Development Goals objective 3.2. However, the mortality rate in Mexico for children under the age of 5 is still double the rate in the United States, indicating room for improvement[6]. Though mortality rates are on the decline, millions of children under the age of 5 die yearly, with many deaths resulting from avoidable causes[7]. In addition, research shows that these deaths are concentrated in low-income and marginalized communities.

Previous studies have shown that there is still a barrier to seeking care, specifically for caregivers of children under the age of 5[8]. A collaborative study by the Institute of Health Metrics and Evaluation (IHME) and the University of Yucatan (UADY) developed a project to understand the bottlenecks in the search for care in communities in the State of Yucatan. Hernandez et al. examined child fatalities in Yucatan, Mexico, and conducted verbal autopsy interviews with caregivers to identify the challenges they faced in obtaining critical care[9]. Upon analyzing verbal autopsy interviews, findings showed that most significant delays appear to arise from caretakers' decision to seek medical care[7,9]. The decision to seek care involved the caregiver identifying the symptom or alarm signs and then initiating a search for care. To seek timely care in a health facility, caregivers need to identify the warning signs and symptoms of common diseases that could affect children under five, and failure to do that can have fatal outcomes [10].

In addition, research also shows that the number of alarm signs the caregiver is aware of can increase the likelihood of seeking care for children under 5 facing different health problems[11]. It is widely supported that maternal education plays a role in their child's health outcome, particularly in the early years[12]. There has also been extensive research on the effects of family size on child outcomes from an economic perspective[13,14]. While this research has extended to

other fields, such as educational outcomes and future performances, little research has been done on the impact of family size on a child's health outcomes.

To effectively address the issues identified in the first phase of the project, IHME and UADY collaboratively developed a community intervention in low-income and indigenous communities of Yucatan to increase awareness and knowledge surrounding recognizing alarm signs in children under five, hence leading to a timelier seeking of care. This project builds upon previous projects conducted by IHME and UADY. Initial analysis showed the intervention effect to be positive but not significant in the whole study population[2]. However, further research is required to explore the impact of the intervention in important subgroups of the population. This thesis project will draw upon existing data to investigate whether there is a differential impact of the intervention on alarm sign recognition when stratified by education and household size, defined by number of household members.

The objectives of the study are:

1. Evaluate whether a community intervention has a differential impact in the following subgroups education and household size in low-income communities in Yucatan in increasing recognition of alarm signs in children under five.
2. Investigate which subgroups had the largest difference in the number of alarm signs recognized between baseline and end-line values.

Methods

Interventional Study

The intervention team recruited fifty women from the eight communities to participate in the study (400 total target participants) with four communities in the intervention group and four communities in the comparison group. This project included a community intervention aimed to improve caregiver's knowledge of alarm signs and symptoms for common causes of death and morbidity in children under five in the hopes of triggering a faster search for care. After the intervention duration of six months was completed, researchers collected post-intervention data on the same topics as the baseline measurement.

Initially, the intervention included workshops about healthcare and risks during childhood and strategies for care seeking. Additionally, the interventional team also planned to conduct discussions regarding necessary improvements for women to prevent morbidity and mortality in children under five. However, due to the COVID-19 pandemic, the intervention team had to

modify the intervention to adhere to public health safety rules. Informational materials developed by the UADY intervention team replaced the informative workshops. The infographics also included materials on COVID-19 health practices to reduce the spread of the virus within rural communities of Yucatan. communities.

Participants filled out questionnaires at baseline containing household information, education level of caregivers, employment status, and asset assessments. Questions to assess alarm sign knowledge and history of healthcare-seeking practice were adapted from a questionnaire utilized in an earlier phase of the Yucatan study[9]. The questionnaire evaluated alarm sign knowledge for the following health conditions: general medical attention, sepsis, respiratory infections (pneumonia), and congenital heart defects. Researchers collected changes in critical indicators post-intervention implementation as well. Baseline data were collected in person between January and March 2020 on the electronic survey software project called SurveyCTO. Due to the emergence of the COVID-19 pandemic, follow-up data were collected using paper surveys between September 2020 and November 2020 with condensed questionnaires. Since follow-up interviews were intended for caregivers who complete baseline interviews, the caregiver's education level was omitted from the list of questions.

Evaluation Design

The intervention was evaluated using an experimental design with pre-and post-intervention data in intervention and comparison groups. This study took place in eight rural municipalities of Yucatán, Mexico, with random allocation of four to intervention (Sotuta, Bokoba, Buctzotz, and Chapab) and four to control (Cantamayec, Dzan, Tekantó, and Calotmul).

Variables: Outcome, Exposure, Control

The primary outcome variable for this study is recognizing alarm signs and we will compare the change in alarm signs recognized over time in the intervention and comparison groups. Additional analysis was conducted with the follow-up data to identify differences in alarm sign recognition between the intervention and comparison groups as well. To assess baseline

knowledge of alarm signs, caregivers were asked if they could identify three or more alarm signs for each of the following categories:

a) General medical attention
b) Infection/Sepsis
c) Respiratory Infection/Pneumonia
d) Congenital Heart Defect

The number of alarm signs recognized under each category (general, sepsis, respiratory infection, congenital heart defect) and the total was collected pre-intervention and post-intervention in the intervention and comparison groups. The primary exposure variable for this study is the intervention program that is being evaluated. Whether the caregiver is given the intervention will be considered the exposure variable. Other variables that may be related to the knowledge of alarm signs were controlled, including the caregiver's age, gender, marital status, education level, and household size. Participants who had an education of primary school or less were classified into the low education group. Participants who had a household size of less than five members were classified into the low household size group.

Ethical Considerations

For ethical purposes, the four communities that chose to be control groups also received the intervention after the data collection period ended. Additionally, all participants went through a thorough informed consent process with the study team, using information and protocols approved by the University of Washington, UADY, and Yucatan Ministry of Health.

Data Analysis

As the intervention was randomized, the data collected was analyzed as a pretest-posttest study design. Additionally, it was analyzed using a difference-in-difference approach with the data collected pre- and post-intervention. We conducted Ordinary Least Squares (OLS) regression analyses on the follow-up data to look at differences in alarm sign recognition at endline overall and among various socioeconomic subgroups. Power calculations show that with approximately 400 participants at baseline and follow-up, power of 84% to identify a 15-percentage point change

between baseline and follow-up (assuming 50% at baseline). We controlled for other variables that might have been related to the change in alarm sign recognition, including caregiver's age, gender, education, and household size.

To test if the randomization of communities was effective in generating comparable groups, we conducted t-tests between the control and interventional group in the following variables at baseline: education, age, and household size. In order to identify the significance in average alarm signs recognized post-intervention in the control and experimental group stratified by education, age, household number, we conducted OLS regressions and t-tests with standard errors clustered by community.

OLS Regression

Equation 1 is the crude regression model used to identify changes in the number of alarm signs recognized at endline when stratified for education and household. We also conducted an adjusted regression model (Equation 2) adjusted for household size and education to identify the relationship and control for potential confounders and any random differences in household characteristics between average alarm signs placed post-intervention in the intervention and comparison group.

Equation 1 (Crude):

Mean Total Alarm Signs at Endline = $\beta_0 + \beta_1$*[Intervention],

where education, household size, and intervention groups were coded as binary variables with high education, high household size, and intervention group coded as 0 and low education, low household size, and comparison group coded as 1.

Equation 2 (Adjusted):

Mean Total Alarm Signs at Endline = $\beta_0 + \beta_1$*[Education] + β_2*[Household Size] + β_3*[Intervention]

Difference-in-Difference analysis

To assess whether the intervention caused differences in the mean alarm signs identified over time between baseline and endline as well as to account for non-observable time-varying factors that could have affected alarm sign recognition, we conducted a difference-in-difference analysis. The difference-in-difference technique (DID) uses longitudinal data from treatment and control groups to obtain information to estimate a causal effect[15]. DID controls for differences in

the levels in control and intervention groups and assumes trends would have remained parallel in the absence of the intervention. The mathematical formula that represents the DID framework is below:

Equation 3:

$Y= \beta_0 + \beta_1$*[Intervention] + β_2*[Post-intervention Time] + β_3*[Post-Intervention Time*Intervention] + λ*[Covariates]+ε

This analysis estimates the impact of specific interventions by comparing outcomes over time between the intervention and control groups. β_0 represents the intercept, β_1 controls for differences in the pre-intervention levels in the intervention groups, β_2 represents the time trend in the comparison group and β_3 represents the intervention effect. This regression was implemented for all households and separately for each of the four sub-groups (low education, high education, low household size, and high household size).

In order to identify a differential impact of the intervention, we replicated the OLS regression analysis and DID analysis stratifying by education and household size.

Results

The UADY team completed 547 caregiver interviews across the eight municipalities at baseline. The UADY team attempted to establish contact with the same households interviewed at baseline and conducted 500 interviews for the follow-up. Due to the constraints of the pandemic, it was not possible to locate all the baseline participants. The UADY team added additional caregivers to the study at baseline and follow-up measurements. Out of the total follow-up participants, 307 (61.4%) were the same caregivers at baseline. Among the 307 participants, 137 caregivers were in the intervention municipalities, and 170 caregivers were in the comparison municipalities.

Table 1 outlines the demographic characteristics of caregivers that provided complete information at baseline or follow-up. Education was the only variable in which there were significant differences between intervention and comparison groups (p-value = 0.026). Given the lack of differences generally between the two groups, we conclude that randomization was effective.

Table 1: Characteristics of participants at baseline and follow-up

Characteristics at baseline	BASELINE	
	Intervention n (%)	Comparison n (%)
	n = 137	n = 170
Gender		
Female	136 (99.3%)	168 (98.8%)
Male	1 (0.7%)	2 (1.2%)
Age Range		
18-25	36 (26.3%)	49 (28.8%)
26-35	64 (46.7%)	78 (45.9%)
36-45	27 (19.7%)	32 (18.8%)
46-55	7 (5.1%)	8 (4.7%)
56-65	3 (2.2%)	2 (1.2%)
>66	0 (0.0)	1 (0.6%)
Education		
Low Education*	34 (24.8%)	45 (26.5%)
High Education*	103 (75.2%)	125 (73.6%)
Household Members		
<5 Members	103 (75.2%)	125 (73.5%)
>5 Members	34 (24.8%)	45 (26.5%)

* Education data only available at baseline. p-value <0.05 between intervention and comparison groups

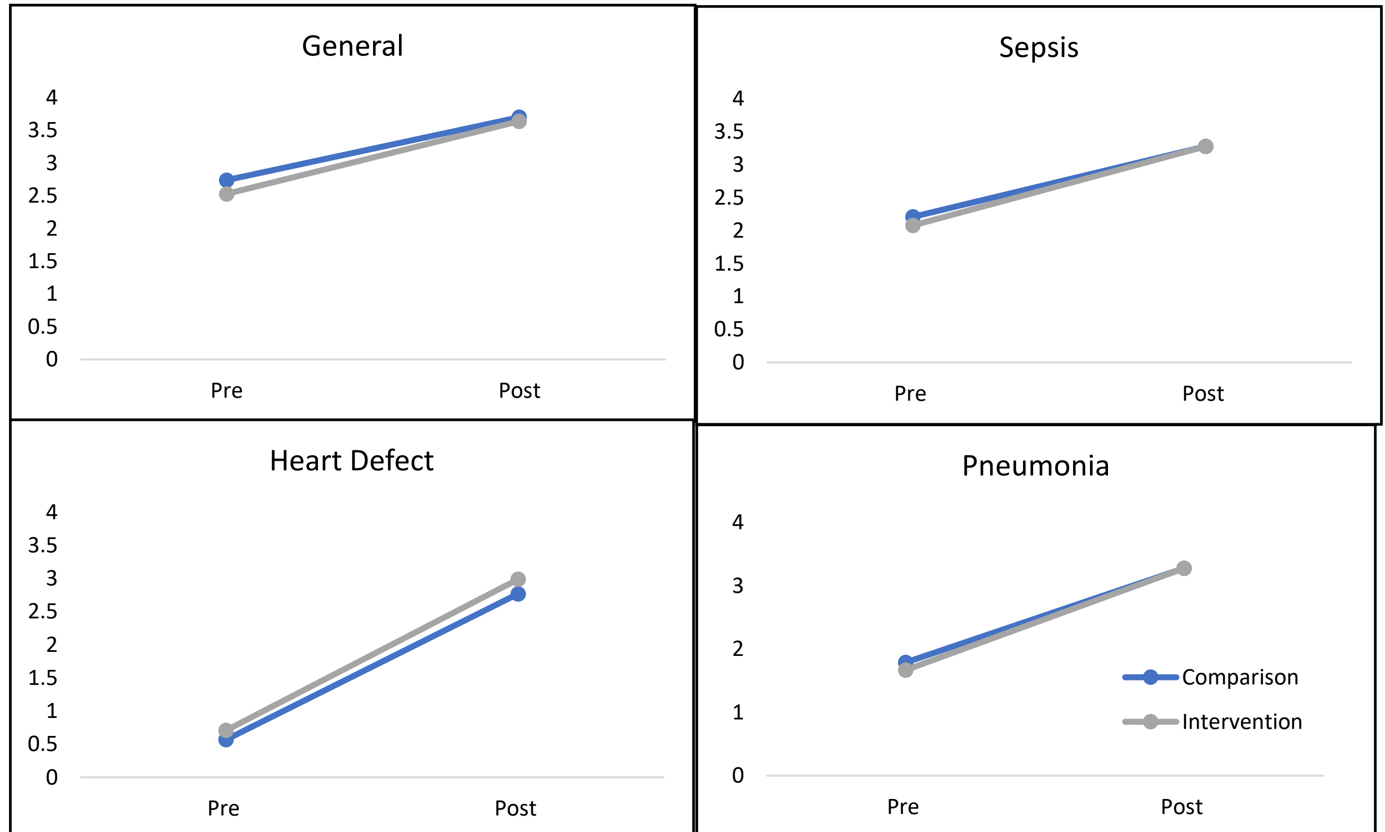
Table 2 shows the mean number of alarm signs identified by caregivers for each sign of alarm category and the total number of alarm signs across the four categories in comparison and intervention groups at baseline and follow-up.

Table 2: Mean number of alarm signs identified in Intervention and Control groups at baseline and endline

Alarm Sign Category	Baseline Mean (95% CI)		Endline Mean (95% CI)	
	Intervention	Control	Intervention	Control
	n = 137	n = 170	n = 137	n = 170
General	2.53 [2.36,2.70]	2.74 [2.60,2.88]	3.64 [3.48,3.79]	3.70 [3.53,2.87]
Sepsis	2.08 [1.89, 2.27]	2.21 [2.03,2.38]	3.28 [3.11,3.44]	3.28 [3.12,3.44]
Pneumonia	1.67 [1.47, 1.87]	1.79 [1.63,1.96]	3.28 [3.11,3.44]	3.28 [3.11,3.45]
Heart defect	0.71 [0.53,0.88]	0.57 [0.42, 0.71]	2.99 [2.85,3.14]	2.77 [2.55,2.99]
Total Alarms	**6.99 [6.47,7.52]**	**7.31 [6.87,7.74]**	**13.2 [12.7,13.6]**	**13.0 [12.6,13.6]**

The results from table 2 are also visualized below in Figure 1, which displays the increase over time in alarm sign knowledge for comparison and intervention groups across the four-alarm sign categories.

Figure 1: Change in mean number of alarm signs identified at baseline and endline in intervention and comparison groups (Comparison: n = 170; Intervention: n = 137).



Results from the adjusted OLS regression analysis (Equation 2) looking at the total alarm signs between intervention and comparison groups showed a mean end total sign of alarms for the Comparison group is 13.0 and for Intervention group to be 13.2
and a p-value of 0.63, which does not give us sufficient evidence to identify a significant difference between mean alarm sign knowledge in intervention and control groups after the intervention when adjusted for education and household.

We ran simple linear regression models using Equation 1 looking at total mean alarm signs for each subgroup at endline (low education, high education, small household size, high household size). We found a significant association between mean total alarm signs and intervention in the low education group. From the crude analysis stratified by education we found the mean endline

total sign of alarms for the Comparison group is 11.2 and for Intervention group to be 13.9, with a p-value of 0.047 indicating a significant difference between mean total alarm signs in intervention and control groups after the intervention in the low education group.

We then analyzed mean alarm signs identified for each category: general illness, infection/sepsis, respiratory disease/pneumonia, and a congenital heart defect. We conducted regression analyses similar to Equation 2 and simple linear regression models for each subgroup (low education, high education, small household size, high household size) using equation 1. Overall, all the p-values for the models were over 0.05, indicating insufficient evidence to identify an association between mean alarm signs at endline for each alarm sign category when adjusting for education levels and household sizes. However, in the sub-group analysis, we identified a significant effect of the intervention on mean alarm signs at endline in the General Signs category in the high household size group. From our analysis, we found the mean number of general alarm signs identified in the comparison group to be 3.38 and in the intervention group to be 3.84, with a p-value 0.024 indicating a significant difference between the mean general alarm signs identified in intervention and control groups in the high size household groups.

Tables 3 and 4 shows results from the crude and adjusted DID, controlling for education and household size, which both impact knowledge and child health outcomes[12–14]. Caregivers with primary education or less were classified to have low education and caregivers living in a household size of less than five were classified into the low household size group.

Table 3: Estimate of the intervention effect (β) and 95% confidence interval (CI) (n = 307)**

Variable	Crude Model	Adjusted*
	β (95% CI)	β (95% CI)
Total alarms		
Time***	5.72 [5.09,6.36]	5.72 [5.09,6.35]
Intervention	- 0.41 [-2.11,1.30]	-0.42 [-2.10,1.25]
Time * Intervention	0.47 [-0.48,1.42]	0.47 [-0.48,1.41]
Constant	7.40 [6.20, 8.59]	6.19 [4.79,7.60]
General		
Time	0.96 [0.75,1.17]	0.96 [0.75,1.16]
Intervention	-0.22 [-0.59, 0.15]	-0.23 [-0.60,0.14]
Time * Intervention	0.14 [-0.16,0.45]	0.14 [-0.16,0.45]
Constant	2.75 [2.47,3.01]	2.35 [1.99,2.71]
Sepsis		
Time	1.07 [0.84,1.30]	1.07 [1.52,2.31]

Intervention	-0.15 [-0.55,0.25]	-0.15 [-0.55,0.25]
Time * Intervention	0.13 [-0.21,0.47]	0.13 [-0.21,0.46]
Constant	2.22 [1.94,2.50]	1.91 [1.52,2.31]
Pneumonia		
Time	1.49 [1.50,2.14]	1.49 [1.26,1.71]
Intervention	-0.15 [-0.60,0.31]	-0.15 [-0.60,0.30]
Time * Intervention	0.12 [-0.22,0.45]	0.12 [-0.22,0.45]
Constant	1.82 [1.50,2.14]	1.62 [1.20,2.04]
Heart Defect		
Time	2.21 [1.99,2.42]	2.21 [1.99,2.42]
Intervention	0.11 [-0.52,0.74]	0.11 [-0.52,0.73]
Time * Intervention	0.08 [-0.25,0.40]	0.08 [-0.25,0.40]
Constant	0.61 [0.16,1.05]	0.29 [-0.22,0.81]

*Adjusted for education and household size clustered at community level **p-value >0.05 *** time at post-intervention

Table 4: Estimate of the intervention effect (β) and 95% confidence interval (CI) stratified by education level and household size* (n = 307)

Variable	Low Education	High Education	Low HH	High HH
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Total alarms				
Time***	5.78 [3.67,7.89]	5.72 [5.06,6.38]	5.79 [5.03,6.55]	5.53 [4.40,6.67]
Intervention	0.42 [-1.79,2.64]	-0.44 [-2.12,1.24]	-0.33 [-1.98,1.31]	-0.46 [-2.76,1.83]
Time * Int.	2.22 [-0.91,5.36]	0.25 [-0.74,1.24]	0.10 [-1.02, 1.23]	1.56 [-0.17,3.28]
Constant	5.44 [3.95,6.94]	7.56 [6.39,8.74]	7.49 [6.33,8.65]	7.06 [5.46,8.66]
General				
Time	0.94 [0.31,1.57]	0.96 [0.74,1.17]	1.05 [0.81,1.30]	0.69 [0.31,1.06]
Intervention	-0.01 [-0.60,0.71]	-0.24 [-0.59,-0.11]	-0.18 [-0.58,0.21]	-0.29 [-0.78,0.19]
Time * Int.	0.39 [-0.54,1.32]	0.11 [-0.21,0.44]	-0.06 [-0.42,0.30]	0.72 [0.15,1.30]**
Constant	2.32 [1.83,2.72]	2.79 [2.55,3.04]	2.76 [2.48,3.03]	2.69 [2.37,3.02]
Sepsis				
Time	1.5 [0.60,2.40]	1.02 [0.79,1.25]	1.09 [0.82,1.35]	1.02 [0.59,1.45]
Intervention	0.04 [-0.89,0.98]	-0.15 [-0.56,0.25]	-0.03 [-0.42,0.36]	-0.47 [-1.14,0.19]
Time * Int.	0.50 [-0.83,1.83]	0.08 [-0.26,0.42]	-0.05 [-0.44,-0.35]	0.65 [-0.01, 1.31]
Constant	1.56 [0.92,2.19]	2.29 [2.01,2.57]	2.21 [1.94,2.48]	2.25 [1.79,2.71]
Pneumonia				
Time	1.39 [0.66,2.12]	1.5 [1.26,1.73]	1.46 [1.19,1.73]	1.56 [1.15,1.96]
Intervention	0.46 [-0.31,1.22]	-0.21 [-0.66,0.24]	-0.14 [-0.59,0.30]	-0.13 [-0.83,0.55]
Time * Int.	0.34 [-0.74,1.43]	0.09 [-0.26,0.44]	0.12 [-0.28, 0.52]	0.12 [-0.49,0.73]
Constant	1.23 [0.76,1.79]	1.87 [1.55,2.19]	1.83 [1.51,2.14]	1.8 [1.32,2.28]
Heart Defect				
Time	1.94 [1.31,2.58]	2.24 [2.00,2.47]	2.18 [1.92,2.44]	2.27 [1.89,2.65]
Intervention	-0.22 [-0.98,0.53]	0.16 [-0.50,0.80]	0.02 [-0.61, 0.65]	0.46 [-0.33,1.25]
Time * Int.	0.99 [0.05,1.93]**	-0.03 [-0.38,0.32]	0.08 [-0.30,0.48]	0.06 [-0.52,0.63]

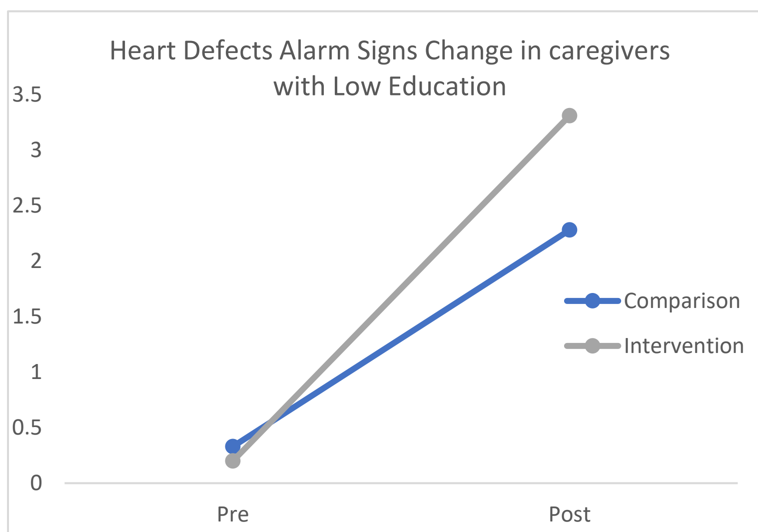
Constant	0.41 [-0.11,0.92]	0.61 [0.16,1.05]	0.69 [0.24,1.13]	0.30 [-0.25,0.85]

*Models are stratified by low education (primary or less) and high education (secondary or more) and by household size (≥5 members, = high HH, <5 = low HH)
** p-value <0.05, *** time at post-intervention

The interaction term "Time*Int." is the intervention effect. The crude model, adjusted only for clustering at the municipality level, shows a positive relationship between intervention and identifying a higher number of alarm signs during the follow-up survey, though not statistically significant. The adjusted model, which controls for education level and household size and clusters at municipality level, shows results nearly identical to the crude model with the intervention effect being positive but not statistically significant.

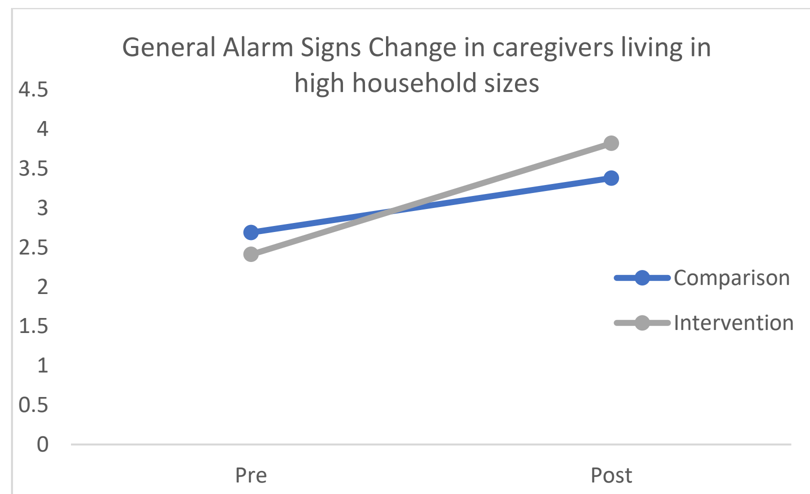
Table 4 shows the model stratified by education and household size, with the first two columns depicting stratification by education and the last two columns by household size. The DID model stratified by education shows us caregivers with an education level of primary school or less increased their knowledge of heart defect alarm signs by reporting nearly one additional sign of alarm (0.99, 95% CI 0.05,1.193) There results are supported by the regression analysis results indicating a significant effect of the intervention in identifying a larger number of alarm signs in the Heart Defect category in the low education group (see fig 2.). However, caregivers with an education level of secondary school or higher did not experience a statistically significant intervention effect for the same alarm sign category.

Figure 2: Change in mean number of heart defect alarm signs identified at baseline and endline in caregivers with low education



Similarly, the DID model stratified by household size shows us that caregivers living with six or more members increased their knowledge of general alarm signs (0.72, 95% CI 0.15,1.30). There results were supported by the regression analysis, where both show a significant effect of the intervention in identifying a larger number of General alarm signs amongst caregivers in the high household size group (see fig. 3). Caregivers living with five or fewer household members did not experience a statistically significant increase in intervention effect within the same alarm sign category.

Figure 3: Change in mean number of general alarm signs identified at baseline and endline in caregivers in high household size group



Discussion

Results from this analysis show an improvement in knowledge among caregivers of children under five between baseline and follow-up measurements. From our results, it is evident that the intervention, though not having an effect on the overall population, had a positive effect in the increase in heart defect alarm signs recognized and general alarm signs recognized in caregivers with low education and caregivers in high household sizes. These results are supported by existing data showing that maternal education levels have an impact on child health outcomes. There is existing evidence suggesting that low education and poor housing, such as large family size in a low-income setting, can lead to deleterious health outcomes for children who grow up in these areas[16]. Thus, it is possible that educational interventions such as this provide new knowledge for caregivers with low education and make there interventions more effective in this subgroup.

These results also stand consistent with current literature surrounding the impacts of household size and caregiver education on child health outcomes. Two recent individual analyses conducted on women in East Africa and India highlighted a strong association between maternal education and child medical care access[12,17]. From the DID analysis, caregivers with primary education or less observed a more significant intervention effect than caregivers with secondary education or more, although the effects were not statistically different. Caregivers with low education in the intervention group had an average baseline mean of 0.2 for heart defect alarm signs recognized compared to Caregivers with high education had an average baseline mean of 2.5 for heart defect alarm signs. This shows that caregivers with higher education started with higher knowledge compared to caregivers with low education indicating that caregivers with low education had more room for improvement. With the observation of a substantial impact of the intervention in heart defect alarm sign recognition in the low education group, it does highlight that education is a significant predictor variable. Both analyses highlight similar results; it shows a more substantial effect of the intervention in caregivers with low education and caregivers living in households with a higher number of members. Further analysis is required to explore the details of these effects and observe additional intervention effects in other subgroups.

Limitations

One of the main limitations of this intervention project was the impact of the COVID-19 pandemic on data collection. Information materials replaced workshops to be mindful of COVID-19 restrictions. Due to this, there was no way to monitor whether caregivers reviewed intervention materials. This may have reduced the effect of the intervention, and therefore presents the evaluation as a conservative assessment. Another limitation was the difference in data collection methods at baseline and follow-up surveys. Baseline data were collected in-person electronically using the software program SurveyCTO, whereas follow-up data were collected using paper surveys with condensed questionnaires. The study team manually entered follow-up data into SurveyCTO after data collection ended. Due to limited space in a paper survey, some questions were edited and removed. However, no change was made to the wording or formatting of caregiver knowledge of alarm signs. An additional potential limitation of the study is the impact of a spillover effect between the intervention and comparison municipalities. It is possible that the intervention information transferred to the comparison municipalities through social and economic

interactions caused by the proximities of the municipalities providing more insight to the overall increase in alarm sign recognition in the comparison and intervention groups.

Additionally, as this intervention program carried on during a pandemic, COVID-19 pandemic effects likely acted as a confounder. A discussion with local stakeholders confirmed that with the onset of the COVID-19 pandemic, communities had been approached by various health promotion programs, leading to an overall increase in alarm sign recognition during the duration of the study. Finally, due to the limited size of our observation window, due to the pandemic, we could not assess if the change in knowledge of alarm signs was translated into a different health seeking behavior.

The results and information gained from these outcomes have upstream impacts. Further investigation of this community intervention can shed light on whether it led to a timelier search for care among women in this community and empower women by providing them an opportunity to build childcare knowledge.

Conclusion

The COVID-19 Pandemic highlighted the importance of detecting COVID-19 alarm signs rapidly and responding appropriately. However, the need for increased detection of alarm signs goes beyond this pandemic to broader ranges of health issues. Hence, this intervention and subsequent analyses of its success are highly relevant to the current situation. In addition, this intervention can be set as an example for implementing similar programs in neighboring communities in Mexico. Data from this study can provide strong evidence in developing interventions and health policies in Yucatan and other Mexican states and regions.

This study shows a positive increase in alarm sign identification after a community intervention, and a significant intervention effect in caregivers with lower education and living in larger household sizes. This intervention program shows a need to increase community awareness of alarm signs and address any presenting challenges with seeking care promptly. Further analysis is needed to capture more detail of these effects. Still, this intervention analysis marks more community interventions to improve alarm sign education and access to timely care.

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