



RESEARCH ARTICLE

# Community Engagement to control dengue vector in two municipalities of Aragua State, Venezuela

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## Abstract

A safe and effective dengue vaccine is not ready yet; therefore, dengue prevention is necessary to control the spread of this infection. Lowering dengue disease depends on controlling mosquitoes by reducing Aedes habitats counting with community participation. We studied community participation on habitat reduction for immature stages of Aedes aegypti in two urban communities of the Aragua State from May 2009 to November 2018. The sample consisted of 100 houses of one community and 400 houses of the other. Fisher's exact test was used to compare the proportions of positive houses or containers through the study period. House index, container index, and Breteau Index were calculated. The data were analyzed using Minitab 20.4 statistical software. The research team initiated the approach to the communities by contacting some of their natural leaders in January 2009. The methodological strategies included workshops, lectures, seminars, document and video reviews, practices, discussions, and knowledge sharing within and with the community. After six months of the intervention, a significant reduction in the Aedes larval indices was found in both communities and lasted for the entire study period. The intervention increased public consciousness and participation in dengue vector control measures in residential areas, and this behavior change was sustainable over time.

Key words: Communities, entomologic indices, Vector Surveillance, Dengue, Venezuela

## INTRODUCTION

The World Health Organization recommends vector surveillance to predict outbreaks and evaluate control (WHO 2011). Therefore, the programs for dengue control

have as a priority to reduce Aedes habitats counting with community participation (Espino et al. 2004); accordingly, working with communities has been growing in many endemic countries (Alvarado-Castro et al. 2017; Sayono et al. 2019; Gopalan et al. 2021). The spread of the dengue virus includes several factors, and one of the dominant is rapid urbanization which increases the water demand that is not satisfied by the authorities (Gubler and Clark 1996). As a response, households accumulate water in containers which originates habitats for the vector. This issue happens in Venezuela, where dengue is endemic, with variable and frequent epidemics inside the country (Grillet et al 2019). Even though this situation causes a public health problem, few studies have taken place with Venezuelan communities aimed mainly at increasing the people's dengue health education (Álvarez and Barcos 2004; Hoyos et al. 2010; Martínez et al. 2015). The Aragua State has been one of the most affected in the country (Velasco-Salas et al 2014) thus, we studied the impact of a community engagement approach on habitat reduction for immature stages of *Aedes aegypti* in two communities of the Aragua State.

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## MATERIALS AND METHODS

We conducted our study in two urban communities of the Aragua State: La Parcela 28-Santa Inés (10° 12' N, 67° 32' W) of Francisco Linares Alcántara (FLA) municipality with 200 houses and the Sector 4-Urbanización Caña de Azúcar (10° 16' N, 67° 37' W) of Mario Briceño Iragorry (MBI) with 805 houses (Fig. 1). The communities were selected for intervention based on the number of confirmed dengue cases, interest in participating, and to have a similar social-economic background. Both communities have irregular water supply and households have to store water in containers, and water stagnation is common. Urban work is the predominant livelihood activity. To calculate the sample size of the houses, we assumed that 50% of the population were aware that mosquitoes cause dengue since both communities have suffered dengue several times and received information from the health authorities. Therefore, we considered a minimum sample size of 500 houses in a total amount of 1005 with a 95% level of confidence and an estimation error of 3%. Each community participated in the sample with 50% of its total houses: FLA with 100 houses and MBI with 400. The selection of the houses was accomplished by simple random sampling, using data from the census carried out by the organized communities.

A container found with a larva or pupa was considered positive for the presence of immature mosquito stages; a house with positive containers was also considered positive for the presence of immature mosquito stages. Fisher's exact test (5% level of significance) was used to compare the proportions of positive houses or containers through the study period. The data were analyzed using Minitab 20.4 statistical software (Minitab, LLC, Pennsylvania, USA). According to the entomological data, house index (HI), container index (CI), and Breteau Index (BI) were calculated. The HI was the percentage of houses or premises infested with larvae or pupae, and was calculated by formula,  $HI = (\text{infested houses or premises} / \text{houses or premises inspected}) \times 100$ ; the CI was the percentage of water-holding containers infested with larvae or pupae,  $CI = (\text{containers positive with Aedes immature stages} / \text{containers inspected}) \times 100$ ; the BI was the number of containers positive with Aedes immature stages per 100 houses inspected, and was calculated by formulae,  $BI = (\text{number of positive containers} / \text{houses inspected}) \times 100$ . We use the traditional Aedes larval indices as reference (WHO 1971). Whenever  $HI < 4\%$ ,  $BI < 5$ , and  $CI < 3\%$ , an urban area is considered a low risk of dengue transmission.

Ethical approval from the Ethics Committee of the Instituto de Investigaciones Biomédicas of the Universidad de Carabobo was obtained. This study was conducted from May 2009 to November 2018, and informed consent from each participant was given.

## RESULT OF STUDY

The research team initiated the approach to the communities by contacting some of their natural leaders in January 2009; they visited households who, through direct contact, received the basis of entomological control of dengue. In addition, the research team invited them to the dengue education sessions planned. This pre-intervention phase allowed knowing the basic level of some entomological indicators in both communities by collecting, counting and rearing to the adult form in the laboratory for identification all immature stages of the Aedes mosquito present in the containers (Table 1).

After finishing the visits, a total of 150 participants began a continuous process of action research that lasted for four months (February to May 2009). The methodological strategies included workshops, lectures, seminars, document and video reviews, practices, discussions, and knowledge sharing within and with the community. The intervention effect was evaluated by comparing the pre-intervention entomological data with the post-intervention one. The research team evaluated the reduction of Aedes immature forms for the first time after six months of the intervention. Table 1 showed an overall substantial decrease in the entomological indices after the intervention in the two communities.

During the dengue education sessions, several community members (around 15 for FLA and 65 for MBI) showed an outstanding positive attitude that facilitated their health education formation. Therefore, the research team counting on these motivated and committed "Dengue Fighters", evaluated the sustainability of the implemented intervention by measuring the indices every six months for three (2012), six (2015) and nine (2018) years (Table 1).

## DISCUSSION

This study confirmed that community engagement, through educational training by the researchers, could reduce the immature forms of the *Aedes aegypti* mosquito, improving vector control. It may also be worth mentioning that the community and the researchers behaved as good partners demonstrating intense and enthusiastic cooperation. These efforts were successful because of the reduction in the entomological indices after six months of intervention, and this remarkable reduction continued during the nine years of follow-up. FLA was smaller and a better-organized community than MBI; therefore, the education activities resulted in a higher empowerment impact on the fight against the dengue vector in the households of the FLA municipality.

Previous studies of community participation in intervention programs to control the dengue vector also showed positive results (Mahmud et al. 2019; Gopalan et al. 2021; Bigio et al. 2022). These interventions used information, education, and communication strategies that raise consciousness among the inhabitants of the community and spread the correct practices. In general, these interventions lasted no more than three years; however, to the best of our knowledge, our study span for the longest period of time (nine years).

Since the first intervention, the reduction of breeding places for mosquitoes was perceived by the majority of members of the community as an achievement in controlling dengue. Therefore, this finding helped to increase community attention and participation in the activities for reducing vector density. Local community leaders who were confident and well-trained in doing their assigned practices and always wanted to accompany the community during the entomological activities coordinated the participation of each family to eliminate vector breeding places in their own homes.

A limitation of our study is that we associated the entomological indices with exposition to dengue transmission while other reports claimed that it is best assessed by determining adult female *Aedes aegypti* index, which directly contribute to virus transmission (Bowman et al. 2014). However, because of limitations of personnel and finances and the difficulty of the adult mosquito sampling -

Table 1. Entomological results of pre and post-intervention in Santa Inés-FLA municipality and Caña de Azúcar-MBI municipality

Houses / Containers	FLA municipality Santa Inés				MBI Municipality Caña de Azúcar					
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention		
N° inspected houses	May 2009 100 25 (25%)	Nov. 2009 100 1 (1%) (p1<0.001)	2012* 100 2 (2%) (p1<0.001) (p2=1.000)	2015* 100 1 (1%) (p1<0.001) (p2=1.000)	2018* 100 3 (3%) (p1<0.001) (p2=1.000)	May 2009 400 174 (43.5%)	Nov. 2009 400 68 (17%) (p1<0.001)	2012* 400 30 (7.5%) (p1<0.001) (p2<0.001)	2015* 400 27 (6.8%) (p1<0.001) (p2=0.784)	2018* 400 24 (6%) (p1<0.001) (p2=0.773)
N° inspected containers	286	180	150	143	160	5200	4640	2607	1517	1440
N° positive containers	29 (10.1%)	1 (0.6%) (p1<0.001)	2 (1.3%) (p1<0.001) (p2=0.592)	3 (0.7%) (p1<0.002) (p2=0.678)	5 (3.1%) (p1<0.008) (p2=0.726)	320 (6.2%)	98 (2.1%) (p1<0.001)	42 (1.6%) (p1<0.001) (p2<0.155)	34 (2.2%) (p1<0.001) (p2<0.151)	30 (2.1%) (p1<0.001) (p2<0.801)
HI (%)	25.0	1.0	2	1.0	3.0	43.5	17	7.5	6.8	6.0
CI (%)	10.1	0.6	1.3	0.7	3.1	6.2	2.1	1.6	2.5	2.1
BI	29.0	1.0	2	1.0	5	80.0	24.5	10.5	8.5	7.5

• Mean values of two measurements of the entomological indices every six months

• p1: p-value calculated against the pre-intervention results.

• p2: p-value calculated against the results of the previous year.

method, in this study, the evaluation was performed using the immature Aedes stages.

A further limitation of this study was that the public health authorities did not get involved in the study for different reason which are beyond the scope of this paper. These authorities already know the results of this study. It strongly suggests that changes in the health policy that strengthen communication with the communities, provide education and training on vector reduction, and direct support to the communities will improve vector control and, as a result, a rise in community satisfaction with public health services. It is desirable that these authorities soon incorporate community participation in the “Dengue control” program.

## CONCLUSION

The intervention increased public consciousness and participation in dengue vector control measures in residential areas, and this behavior change was sustainable over time.

## Acknowledgement

This paper is in memorial of our dear friend and colleague, Prof. María Martínez, who died prematurely on 2022 (1962-2022). Her primary research interests included vector-borne diseases and control solutions by empowering communities. Her contribution to this study was crucial in the community mobilization process.

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## DECLARATIONS

### Funding.

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### Conflicts of interest/Competing interests.

The authors declare that they have no conflicts of interest.

**Ethics approval** for the study was obtained from the Bioethics Committee of the Biomedical Research Institute of the University of Carabobo (Protocol Number CBIB-UC/2008-009 and the approvals of the continuous annual reports throughout the whole period of the study). People enrolled in the study were all adult and signed a written informed consent.

### Consent to participate and publication.

The named authors (except for María Martínez, who passed away in March last year) read the manuscript and approved it for participation and publication.

**Availability of data and material.**

All data generated during this study are included in this published article.

**Code availability**

'Not applicable'

**Authors' contributions.**

María Martínez and Victor Mijares contributed to the study design and carried out the community mobilization process with material preparation and data collection; Luis Pérez-Ybarra applied the statistics to analyze study data; Nancy Moreno contributed to the study conception and review and editing of the first draft; Flor Herrera conducted the investigation and wrote the initial draft.

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