DOI: 10.1590/1413-81232022271.33312020

Education-based *Aedes Aegypti* control actions: an integrative review

Ítala Keane Rodrigues Dias (https://orcid.org/0000-0003-3027-825X) [1]
Rosa Maria Grangeiro Martins (https://orcid.org/0000-0002-2516-0719) [1]
Cicera Luciana da Silva Sobreira (https://orcid.org/0000-0003-2380-9606) [1]
Rhavena Maria Gomes Sousa Rocha (https://orcid.org/0000-0001-6341-4735) [1]
Maria do Socorro Vieira Lopes (https://orcid.org/0000-0003-1335-5487) [1]

Abstract *The aim of this study was to provide a synthesis of published studies investigating education-based arbovirus control strategies. The data were collected from the LILACS, BDENF and MEDLINE databases using the descriptors "Health Education" and "Aedes", together with the Boolean operator "AND". The searches retrieved 242 studies, 14 of which were included in the review after applying the inclusion and exclusion criteria. The data were analyzed using a qualitative approach, resulting in the identification of four categories: vector control actions based on community capacity building; social mobilization for arbovirus control; education-based vector control combined with biological control; and integrated arbovirus control actions. The findings show that health education is an essential element of arbovirus control and should be implemented in conjunction with other vector control strategies.*

Key words *Vector Control, Aedes, Public Health Surveillance, Prevention & Control, Health Education*

[1] Universidade Regional do Cariri. R. Cel. Antônio Luíz 1161, Pimenta. 63105-010 Crato CE Brasil.
itala_keany@hotmail.com

Introduction

The climate in Brazil, combined with factors such as the size of the country, vegetation, and poor housing conditions and basic sanitation contribute to the occurrence of epidemics of arboviruses transmitted by the mosquito *Aedes aegypti*[1]. Although with some diseases transmitted by arboviruses the patient recovers completely after the acute phase, there are cases in which symptoms can last for weeks or months, leading to the development of bleeding or neurological complications, some of which are irreversible[2,3]. The persistence of arboviruses such as dengue and the prominence of outbreaks of emerging diseases like chikungunya and Zika reveal the country's social and political weaknesses and need for effective vector control strategies[1]. The fact that the World Health Organization (WHO) issued a warning in 2016 declaring the Zika virus (ZIKV) a public health concern after associating the virus with cases of microcephaly illustrates the magnitude of the arbovirus problem, which besides overburdening health services, perpetuates the cycle of poverty in the country[3,4].

Larvicides and insecticides have been widely employed in the absence of vaccines and specific treatment, especially during endemic periods, without achieving vector control[5,6]. These chemical substances result in the development of insecticide resistance and contribute to an increase in the magnitude of future epidemics[7]. These substances have an initially high cost until they reduce mosquito numbers; however, vector numbers increase as resistance evolves[6-8].

Other strategies, such as infecting *Aedes aegypti* with Wolbachia bacteria, have also been applied and assessed. Infection triggers changes in the mosquito's immune system that are capable of interrupting the chain of infection in diseases such as dengue[9].

In 2002, the Brazilian government created the National Dengue Control Program (PNCD, acronym in Portuguese), which proposed changes in the control of arboviruses, emphasizing the importance of social mobilization and public adherence, and encouraging people to take responsibility for managing potential breeding sites. The PNCD was a milestone in arbovirus control in Brazil[10].

Health education has assumed a prominent position in control interventions, being viewed as an essential prevention strategy. Education enables the construction of the foundations of a sustainable society, driving cultural and social changes that facilitate social and environmental improvements that are necessary to strengthen individual and collective care for the environment, which in turn is essential for eliminating the risk of mosquito breeding[8,11].

An integrative review conducted in 2013 investigating health education strategies for arbovirus control used in Brazil found that only a small number of publications associate the fight against these diseases with health education. The study identified the need to change education strategies, making it clear that traditional forms of education have not been enough to motivate the population to implement effective vector control measures[12].

In view of government investment in policies to mobilize public support for the fight against arboviruses and gaps in research in Brazil on control strategies using education actions, this study was designed around the following guiding questions: What education-based arbovirus control strategies have been implemented worldwide and published in the scientific literature? What were the results reported in the respective studies?

The answers to these questions provide a theoretical framework that can support the planning of education-based vector-borne disease response programs and policies aimed at reducing the spread of the main diseases transmitted by the mosquito *Aedes aegypti*. The aim of this study was therefore to provide a synthesis of published studies investigating education-based arbovirus control strategies.

Method

We conducted an integrative literature review, which is a method that enables the collection, critical analysis and synthesis of available evidence on a topic of interest, where the final product is the current state of knowledge on that topic. To this end, we followed the following six stages: 1) identification of the research question; 2) literature search; 3) study categorization; 4) analysis of the studies included in the review; 5) results interpretation; and 6) presentation of the review[13].

The literature search was guided by the following research questions: What education-based arbovirus control strategies have been implemented worldwide and published in the scientific literature? What were the results reported in the respective studies?

A search of the following databases was performed in 2016: Latin American and Caribbean Health Sciences Literature (LILACS), Nursing Database (BDENF), and Medical Literature Analysis and Retrieval System Online (MEDLINE). The Portuguese terms "*Educação em Saúde*" ("Health Education") and "*Aedes*" from the Health Sciences Descriptors (DeCS) were cross referenced using the Boolean operator "AND".

The following filters were applied in all searches: full text availability; studies published between 2010 and 2016. The first filter was applied due to lack of research funding to purchase non-free articles and the second was applied assuming that studies published during this period would provide an up-to-date picture of the knowledge on the topic of interest. We included articles written in Portuguese, English and Spanish.

We excluded letters to the editor and editorials, due to limitations in their scientific rigor, duplicate articles, and studies that were not consistent with the review's aim, as shown in Figure 1 ("Eligibility").

The searches retrieved 242 results. After applying the above filters, the titles, abstracts and full versions of the articles were read to verify whether they met the review inclusion and exclusion criteria, resulting in 59 studies (Figure 1).

The full versions of the 59 articles were then read to identify content and those publications that did not meet the review's objectives were excluded, resulting in a final sample of 14 studies (Figure 1).

The data from the included articles were entered into a Microsoft Excel worksheet and organized into the following categories: authors, article title, journal, year of publication, country, study period, language, type of study, participants, mosquito control interventions, findings, and conclusions.

The data were analyzed using a qualitative approach involving the detailed reading of the articles to identify thematic categories. A total of four categories were identified. To facilitate the understanding of the findings, the data were summarized and compiled in boxes.

Results

The 14 studies included in the integrative review are all scientific articles published in journals. Most of the articles were written in English (N=9, 64.2%), followed by Spanish (N=3, 21.4%) and Portuguese (N=2, 14.2%). Most of the studies adopted an experimental research design (N=9, 64.2%), followed by quasi-experimental (N=3, 28.5%) and an experience report (N=1, 7.1%). The studies were conducted in different continents, predominantly Latin America. The country with the largest number of studies was Brazil (N=3).

The content analysis identified four thematic categories. The first was "Vector control actions based on community capacity building", consisting of six studies shown in Chart 1. The education interventions in these studies were implemented in schools and households. The target audiences were teachers, adults, children, students, community leaders, school janitors and other professionals. The main methods used were capacity building involving the use of leaflets, conferences, workshops, slides, websites and talks.

The second category was "Social mobilization for arbovirus control", consisting of six studies shown in Chart 2. The studies in this category focused on Education interventions involving community mobilization. Actions were developed in neighborhoods, communities and with groups. In addition to the distribution of educational material, the interventions included clean-up campaigns involving litter-picking, group clean-ups, school competitions and collection of recyclable material.

The third category was "Education-based vector control combined with biological control", consisting of just one study using natural predators in conjunction with education actions (Chart 3).

The fourth category, "Integrated arbovirus control actions", consisted of one study of interventions involving education actions integrated with the implementation of public policies (Chart 4).

The interventions that achieved satisfactory results were those that employed multiple arbovirus response strategies focusing on community mobilization, active methods and the involvement of local authorities.

Discussion

The articles were mostly written in English, reflecting the hegemony of this language. The fact that we found studies undertaken in different countries demonstrates that countries from

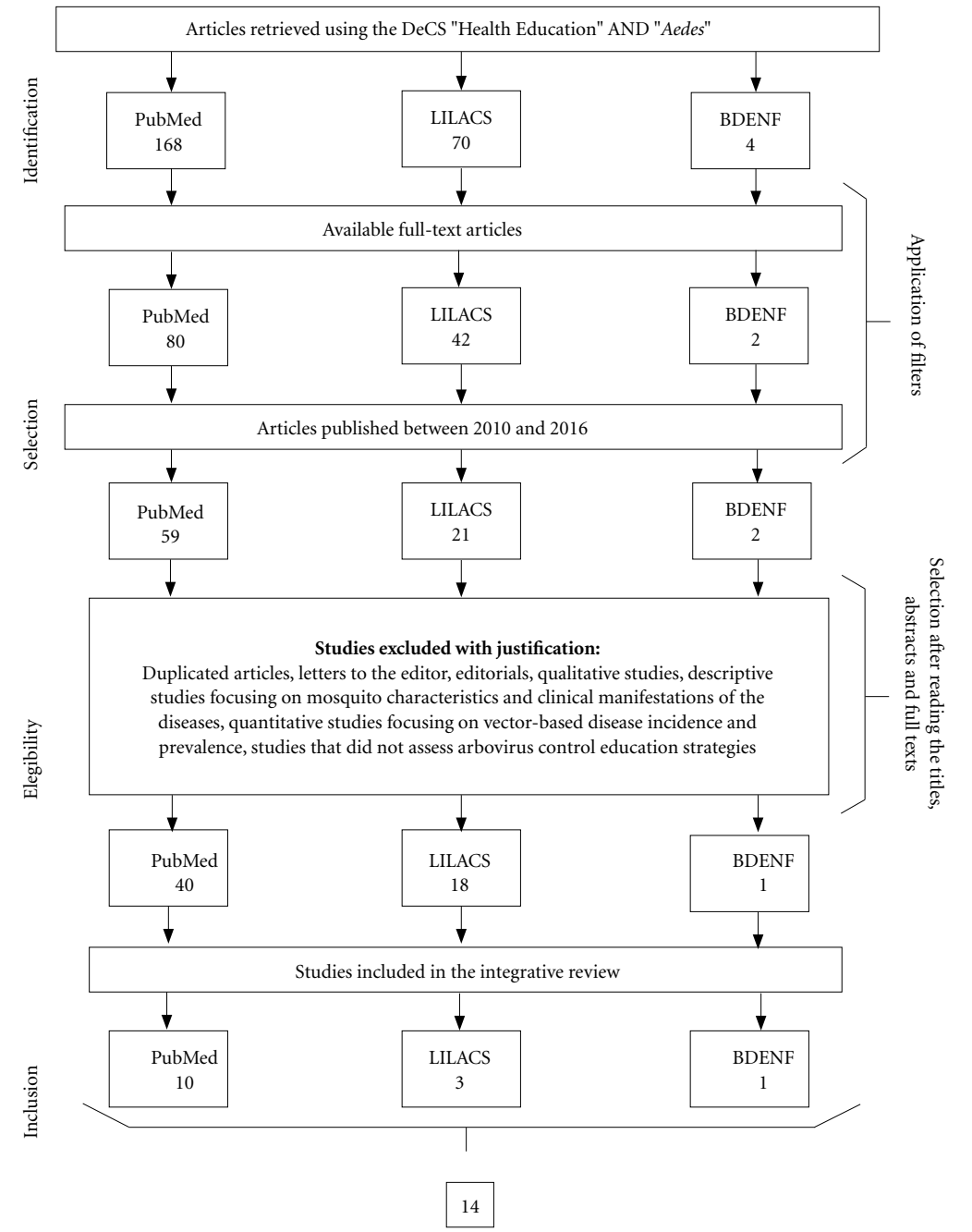

Figure 1. Flow diagram of the study selection process.

Source: Adapted from Galvão *et al.*[14].

different continents are seeking to improve and develop alternative strategies that contribute to the prevention of health problems caused by arboviruses.

The number of studies conducted in Brazil is explained by the environmental and structural factors in the country that contribute to the persistence of health problems caused by *Aedes*, thus demanding a greater focus on research in this area[1]. However, despite the predominance of studies in Brazil, the number of publications may be considered relatively small, given that these

Chart 1. Synthesis of the studies included in Category 1, "Vector control actions based on community capacity building".

Authors/ Country/ Year of publication	Study design/ Language	Interventions	Results
Bartlett-Healy *et al.*[15]/ United States/ 2011	Experimental/ English	The study involved three communities. Teachers in one community were given education materials and instructed how to present lessons. The children who participated in the study received take-home ovitraps to collect mosquito eggs and instructions on how to count eggs and upload data to an Internet site with different computer games. In the second community, the activity was directed at adults, who received educational brochures over the course of the spring and summer. A third community did not receive any interventions	There were no significant differences in source reduction behavior for those individuals receiving education and those not receiving education. However, there was a significant difference in source reduction behavior in those receiving education in the Monmouth county site
Cáceres-Manrique *et al.*[16]/ Colombia/ 2010	Experimental/ Spanish	The study was conducted in four districts. Two received interventions and two were controls. The intervention consisted of home visits to investigate knowledge, practices and population adherence. Subsequently, community leaders received training on vector surveillance, prevention and control	The intervention was effective. Larval index and dengue prevalence decreased by 20% and 4.5%, respectively, in the intervention sites. Larval index and dengue prevalence in the control site were 15.9% and 6.7%, respectively
Contreras *et al.*[17]/ Cuba/ 2012	Quasi-experimental/ Spanish	The study assessed the impact of a dengue education intervention directed at professionals working with vector control in three communities. The educational strategy consisted of conferences, followed by thematic workshops and the distribution of a brochure to participants. Knowledge was measured before and after the intervention	The educational strategy was effective in increasing professionals' knowledge of vector control actions
Hernández-Suárez and Mendoza-Cano[18]/ Mexico/ 2016	Quasi-experimental/ English	The intervention consisted of a campaign focused on training elementary school janitors to locate and avoid breeding sites before the start of the school year. Training included talks using slides, followed by visits to typical breeding sites in the school. Talks lasted an average of 2.5 hours	There was a 45% reduction in dengue incidence compared to the previous year in the schools where janitors received training
Silva *et al.*[19]/ Brazil/ 2013	Quasi-experimental/ Portuguese	The study was conducted in public schools and houses. Home visits were made by the researchers and endemic disease control agents to observe the situation in yards and fill in a checklist. Based on this information, the researchers defined education actions for schools to increase student knowledge of vector prevention and control, drawing on the principles of meaningful learning. Education actions included the following: classes given by the researchers; distribution of the preventive resource "Evidengue®" and an informational brochure. After the education actions, the researchers made another two home visits to observe the situation in yards and adherence to Evidengue®, once again filling out the checklist	The intervention demonstrated potential for vector control. In the first visit, 89.3% of homes had container habitats. At the second and third visits after the intervention, the number of homes with container habitats reduced to 70.0% and 68.0%, respectively
Torres *et al.*[20]/ Mexico/ 2014	Quasi-experimental/ Spanish	The study assessed an educational intervention with 3,124 students (1,562 participated in educational activities and the rest comprised the control group). A survey was conducted to assess knowledge, attitudes and practices before and after the educational strategy. The strategy consisted of a 60-minute talk focusing on the participation of students in self-care and vector prevention and control. The strategy included the observation of real eggs, larvae, pupae and adults and a walk around the school yard to identify and record the types of containers that provide ideal breeding sites	The knowledge, attitudes and practices of the students who participated in educational activities improved significantly, showing a statistically significant difference in all items when compared to the control group

Source: Authors.

Chart 2. Synthesis of the studies included in Category 2, "Social mobilization for arbovirus control".

Authors/ Country/ Year of publication	Study design/ Language	Interventions	Results
Arunachalam *et al.*[21]/ India/ 2012	Experimental/ English	The study was developed in two neighborhood clusters, each containing 1,000 houses. In the intervention clusters, *Aedes* control was carried out using a community-based environmental management approach directly involving the community. Activities included the mobilization of self-help and school groups for dengue prevention, distribution of health education material, clean-up campaigns, waste disposal, and recycling. The control cluster received only the routine government services	Vector infestation levels were significantly lower in the intervention clusters. The pupae per person index was significantly reduced to 0.004 pupae per person from 1,075
Caprara *et al.*[22]/ Brazil/ 2015	Experimental/ English	The study assessed an intervention aimed at reducing *A. aegypti*, comparing 10 intervention clusters and 10 control clusters. Routine vector control activities were conducted in the control clusters, while in the intervention clusters key individuals were identified and underwent training to mobilize the community to participate in an environmental management program (workshops, clean-up campaigns, waste disposal, mobilization of schoolchildren and community groups, and distribution of information, education and communication materials)	Major differences were found between the intervention and control areas before and after the intervention
Costa *et al.*[23]/ Brazil/ 2012	Experience report/ Portuguese	This article describes the implementation of the "Friends of the neighborhood against Dengue" project. Activities included 23 group clean-ups and 10 recyclable material collection competitions in schools. Certificates of participation were handed out and the activities were presented during an event held in the community displaying the recyclable material and featuring plays, puppet shows and popular dance	5,145 breeding grounds were eliminated in 3,258 homes (average of 1.58 breeding grounds per home)
Healy *et al.*[24]/ United States/ 2014	Experimental/ English	The study assessed a source reduction program in which community volunteers were trained to educate their peers on mosquito control and prevention. Active education was conducted by teams who carried out inspections in backyards together with residents, describing current and potential mosquito habitats. A number of community events were organized using printed material and litter-picking	There was a significant reduction of container habitats in the sites where the volunteers actively engaged the community. There was a 22.6% reduction in container habitats in the intervention areas, compared to a 32.3% increase in the control sites
Kittayapong *et al.*[25]/ Thailand/ 2012	Experimental/ English	The study was conducted in three communities. The intervention and control groups were randomly selected. Key community leaders and relevant governmental authorities were identified and trained to conduct vector control activities in their own communities using environmental management in combination with eco-friendly vector control tools. The trained volunteers carried out health education and vector control during home visits, management of public spaces and solid waste management	There was a significant reduction in the pupae per person index in intervention communities during entomological surveys, which were conducted at two-month intervals
Mitchell-Foster *et al.*[26]/ Canada/ 2015	Experimental/ English	The study assessed an integrated intervention strategy (IIS) for dengue prevention (an elementary school-based dengue education program, and "clean patio and safe container" program) implemented in 10 intervention clusters, against 10 control clusters. Special attention was given to social mobilization and empowerment of the participants of the IIS	The IIS was successful. There was a reduction in the pupa per person index in the intervention communities when compared to the control group

Source: Authors.

Chart 3. Synthesis of the study included in Category 3, "Education-based vector control combined with biological control".

Authors/ Country/ Year of publication	Study design/ Language	Interventions	Results
Ghosh *et al.*[27]/ India/ 2011	Experimental/ English	The study assessed the effectiveness of education campaigns using two types of fish (*Poecilia reticulata* and *Gambusia Affinis*) in indoor cement tanks for larval control in three communities. In the first community *Poecilia reticulata* was released into indoor tanks and education campaigns were conducted to educate residents on fish maintenance, mode of transmission and the treatment of diseases transmitted by the mosquito. In the second community, the same activities were developed, but using *Gambusia Affinis*. In the third community *Poecilia reticulata* was released without education campaigns	The use of *Poecilia reticulata* with education campaigns was the most effective means of controlling *Aedes*, reducing chikungunya cases by 99.87%. In the community using *Gambusia Affinis* and education campaigns, chikungunya cases were reduced by 68.51%, while in the community that used *Poecilia reticulata* without education campaigns, cases reduced by 65.48%

Source: Authors.

Chart 4. Synthesis of the study included in Category 4, "Integrated arbovirus control actions".

Authors/ Country/ Year of publication	Study design/ Language	Interventions	Results
Nam *et al.*[28]/ Vietnam/ 2012	Experimental/ English	The study was carried out in 14 communities (12 intervention communities and two controls). The intervention was implemented over a seven-year period. A water supply and sanitation system was implemented and civil society leaders and representatives were trained in workshops and assessed to implement the proposed strategies. At the end of training, the volunteers received household recording books, a house list for each collaborator and an activity schedule. Primary and secondary school teachers were also targeted for training	The project achieved its objectives with high efficiency, effectiveness and sustainability. The mean±SD density of adult female A. aegypti was reduced from 0.93±0.62 to 0.06±0.09 and the reduction of numbers of immature A. aegypti averaged 98.8%. At the end of the project, no adults were collected in six of the 14 communities

Source: Authors.

diseases are endemic in the country. Our findings are consistent with a previous integrative review on the use of education actions to control arboviruses, which found only five publications in Brazil[12].

Category 1 included studies that used education strategies designed to increase public knowledge of arboviruses with the aim of sensitizing participants to interventions that are capable of managing mosquito-breeding habitats, making them vector-free.

The effectiveness of the strategies used in this category depends on community engagement in key aspects of disease prevention, such as mos-

quito management and identifying and eliminating mosquito breeding sites. It is essential to address the impact of the vector on communities and suggest simple control measures to raise public awareness of the importance of adhering to response strategies[17].

Chart 1 shows that the interventions in which the main education strategy was the distribution of educational brochures did not obtain significantly different results when compared to non-intervention areas. Strategies that rely solely on education materials are too passive in motivating the public to implement effective arbovirus prevention measures. Traditional passive means of education, long considered the gold standard for mosquito control, are not sufficient to motivate the public to eliminate mosquito breeding sites[15].

A previous integrative review also showed that many education actions take the form of talks given by qualified professionals, resulting in vertical and unattractive education. These strategies have several limitations that need to be addressed to ensure good quality health education. Factors related to lack of public participation include public resistance to campaigns and the trivialization of the problem, where diseases are seen as part of everyday life rather than a public health problem[12].

A study showed that repeated measures analysis of variance showed significant differences between sites where there was active education and those where passive education was adopted, demonstrating that the former approach is capable of reducing mosquito sources and improving community behavior[24].

With regard to the characteristics of education materials, it was possible to observe that materials with color variations were more effective in conveying the message than black and white material, with the latter showing similar results to interventions that did not provide materials. Education materials should therefore use appropriate language and layout and design to make them as attractive as possible and easy to understand[15].

In addition to homes, schools and other public spaces were chosen as settings for education interventions. This finding demonstrates that there have been major advances in vector control actions, with strategies no longer limiting their scope to households, as observed in previous years[18]. Expanding the scope of actions to include a range of different public spaces is warranted by the fact that these spaces are also common mosquito habitats[24].

A large number of studies included in the review used schools as intervention sites, which are regarded as suitable settings for community-based programs. School-based campaigns are also generally low cost and provide promising results. Through such programs, it is possible to increase the knowledge of school children and improve attitudes and mosquito management practices, strengthening their capacity to promote changes in attitudes towards tackling the diseases transmitted by the mosquito[18,20]. The variation in the age, sex, level of education and occupation of study participants demonstrates the importance an overall population approach and how each population group, according to their particular characteristics, is responsible for combatting and reducing the diseases transmitted by *Aedes* in different contexts, schools, streets, homes and workplaces.

Endemic disease control agents are a priority group among professionals who require continuous training. These agents work directly with vector control and are a direct point of communication with the community, meaning that it is important that they receive continuous training, update their knowledge and improve practices. Factors such as having spent a long time in the profession and lack of work incentives mean that managers should provide periodic refresher training[17].

The analysis of the studies included in category 2 show that vector control strategies have been gradually implemented in a coordinated manner. In addition to capacity building, they include activities involving community participation in the form of group clean-ups and collection of recyclable material. These activities promote the active participation of the community, making it part of vector control efforts. This approach is consistent with the measures proposed by the PNCD[10].

Public participation helps to break the authoritarianism of health care and health surveillance services, reinforcing the need to reflect on public participation in health actions and the incorporation of activities aimed at promoting community participation in the control of endemic diseases into government guidelines[23]. According to some researchers, the strategies that are effective in improving knowledge and practices and empowering the community for the prevention and control of vector-borne diseases are those that involve social mobilization[16].

Our findings also point to the need to train other professionals responsible for maintaining public spaces (school janitors, general cervices

assistants, etc.). The provision of training for these professionals is essential, as they generally demonstrate a high level of confidence in their work and have a low level of education, which can negatively affect mosquito control[18].

Communities with a historically strong organizational culture have greater capacity to cope with this type of problem. On the other hand, poor leadership influences community dynamics, hampering efforts to resolve collective problems. It was possible to observe that arbovirus control strategies in neighborhoods in which people demonstrated initiative, public participation, commitment and leadership were successful[22].

The study included in Category 3 highlights the importance of education actions even when interventions use biological control methods, such as those involving fish species. Biological control using larvae predators in water storage tanks is another alternative adopted by many public managers. However, studies show that biological control without education strategies is not sufficient to reduce larvae[26,27].

The use of fish in water tanks as a control strategy is fairly common in Brazil. Fish species used include *Betta splendens*, *Trichogaster trichopterus*, *Xiphophorus maculatus* and *Poecilia reticulata*. Although all species are effective in eliminating mosquito larvae, when placed in environments that have both larvae and a higher quantity of substrates that the fish also feed on, the fish eat the substrates rather than the larvae[29].

According to the studies, isolated, irregular and vertical larva control programs without any community involvement tend to be unsuccessful[21]. When using natural predators, it is essential to instruct the community on proper water storage practices and alternative fish feed in the absence of larvae[26,27].

Category 4 consisted of an intervention that integrates multiple arbovirus control strategies. Although the education strategies demonstrated great potential, on their own they would be insufficient to prevent this public health problem, with other factors such as the provision of quality public health, infrastructure, security and leisure services playing an essential role[28]. Studies show that, when used on their own, interventions such as health education, biological control and insecticides are not effective, highlighting that the combination of multiple strategies and the involvement of local authorities is essential[30].

The provision of essential services in all communities should be a priority for public managers. This requires investment to revitalize neighborhoods, improve basic sanitation and build roads, sidewalks and parks, the provision of adequate security and waste collection services, improved housing, and the use of different mediums to inform the public about the importance of keeping the environment free from health risks[30].

There is an urgent need for a paradigm shift, moving from a top-down approach to a horizontal one, and the incorporation and strengthening of epidemiological and entomological surveillance[28]. Arboviruses need to be understood as everyone's problem, whose solution lies in uniting states, services, professionals and the population. Responsibilities should therefore be shared and government and civil society should work together to create solutions. The seasonal nature of campaigns should be replaced by permanent education that values popular knowledge and promotes interventions tailored to local realities and culture, and the education process should be horizontal[12].

Although the "war against the mosquito" is a pressing need, it should not conceal the fact that the list of enemies of health is a lot longer. The immediate suspension of cuts in social spending is urgently needed, together with the prioritization of investment in basic sanitation and strengthening of the country's public health care system, the *Sistema Único de Saúde* (SUS) or Unified Health System. Only an efficient health system can ensure the continuity of health care. Furthermore, there is an urgent need to create a scientific agenda that includes major investment in research to better assess the efficacy and cost-effectiveness of interventions implemented in different setttings[30].

Final considerations

The findings show that health education is an essential element of arbovirus control and should be implemented in conjunction with other vector control strategies. Education actions for combating *Aedes aegypti* contribute to improving knowledge and changing community behavior, sensitizing the public to the need to manage mosquito habitats.

The following positive results were associated with the use of education strategies: reduction of mosquito habitats; elimination of breeding sites; decrease in vector infestation levels; and improved vector control knowledge, attitudes and

practices, contributing to the empowerment of communities.

Education interventions focusing on diseases transmitted by *Aedes aegypti* are key actions that should be implemented continuously in a participatory manner and using active methods. These methods have been shown to provide satisfactory results from a health promotion perspective, unlike vertical teaching approaches, which are limited in their ability to motivate the community to control vectors.

Based on the results of this integrative review, it is recommended that public managers and civil society representatives engage in frequent dialogue with all segments of the community to identify the main factors influencing vector control, considering that each community has its own specific characteristics. These actors should define priorities for ensuring that environments are free of vector-borne diseases, including social mobilization, investment in health, security, leisure, infrastructure and, above all, basic sanitation.

Collaborations

All authors participated in the conception of the project, analysis and interpretation of data, writing of the article, critical review of the content and final approval of the version to be published.

References

1. Lopes N, Linhares REC, Nozawa C. Características gerais e epidemiologia dos arbovírus emergentes no Brasil. *Rev Pan-Amaz Saude* 2014; 5(3):55-64.
2. Lima-Camara TN. Arboviroses emergentes e novos desafios para a saúde pública no Brasil. *Rev Saude Publica* 2016; 50:36.
3. Boeuf P, Drummer HE, Richards JS, Scoullar MJL, Beeson JG. The global threat of Zika virus to pregnancy: epidemiology, clinical perspectives, mechanisms, and impact. *BMC Medicine* 2016; 14:112.
4. Fauci AS, Morens DM. Zika Virus in the Americas — Yet Another Arbovirus Threat. *N Engl J Med* 2016; 374:601-604.
5. Carvalho NS, Carvalho BF, Dóris B, Biscaia ES, Fugaça CA, Noronha L. Zika virus and pregnancy: An overview. *Am J Reprod Immunol* 2017; 77:e12616.
6. Al-Muhandis N, Hunter PR. The Value of Educational Messages Embedded in a Community-Based Approach to Combat Dengue Fever: A Systematic Review and Meta Regression Analysis. *PLoS Negl Trop Dis* 2011; 5:e1278.
7. Luz PM, Vanni T, Medlock J, Paltiel AD, Galvani AP. Dengue vector control strategies in an urban setting: an economic modelling assessment. *Lancet* 2011; 377(9778):1673-1680.
8. Seley CM, González LJ, Tornese ML, Marchesi Olid LS, Martínez FN, Rossi ML, Troncoso A. Dengue and dengue haemorrhagic fever: its history and resurgence as a global public health problem: progress and challenges. *Prensa Med Argent* 2009; 96(7):395-406.
9. Batista G, Thomé RCA, Pastore DH, Arruda EF, Dias CM, Yang HM. Modelagem do Aedes aegypti utilizando a bactéria Wolbachia como agente de controle. *XLIX Simpósio Brasileiro de Pesquisa Operacional*; 2017 ago 27-30; Blumenau-SC, Brasil.
10. Brasil. Ministério da Saúde (MS). Fundação Nacional de Saúde (Funasa). *Dengue: aspectos epidemiológicos, diagnóstico e tratamento*. Brasília: Funasa; 2002.
11. Ioosa S, Mallet HP, Goffart IL, Gauthier V, Cardoso T, Herida M. Current Zika virus epidemiology and recent epidemics. *Med Maladies Infect* 2014; 44:302-307.
12. Silva VB, Mallmann DG, Vasconcelos EMR. Estratégias de combate à dengue através da educação em saúde: uma revisão integrativa. *Saude (Santa Maria)* 2015; 41(2):27-34.
13. Mendes KDS, Silveira RCCP, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. *Texto Contexto Enferm* 2008; 17(4):758-764.
14. Galvão TF, Pansani TSA, Harrad D. Principais itens para relatar Revisões sistemáticas e Meta-análises: A recomendação PRISMA. *Epidemiol Serv Saude* 2015; 24(2):335-342.
15. Bartlett-Healy K, Hamilton G, Healy S, Crepeau T, Unlu I, Farajollahi A. Fonseca D, Gaugler R, Clark GG, Strickman D. Source reduction behavior as an independent measurement of the impact of a public health education campaign in an integrated vector management program for the Asian tiger mosquito. *Int J Environ Res Public Health* 2011; 8:1358-1367.

16. Cáceres-Manrique FM, Angulo-Silva MP, Vesga-Gómez C. Eficacia de la movilización y la participación social para la apropiación o "empoderamiento" (sic.) (empowerment) de las medidas de control del dengue, Comuna Norte, Bucaramanga, 2008-2009. *Biomedica* 2010; 30:539-550.
17. Contreras NH, Oliva JN, Francisco NC, Valdés LS, Álvarez HH, Cantelar NC. Impacto de una intervención educativa en trabajadores de la campaña antivectorial. *Rev Cub Med Trop* 2012; 64(3):304-314.
18. Hernández-Suárez CM, Mendoza-Cano O. Empirical evidence of the effect of school gathering on the dynamics of dengue epidemics. *Glob Health Action* 2016; 9:28026.
19. Silva PC, Martins AM, Schall VT. Cooperação entre agentes de endemias e escolas na identificação e controle da dengue. *Rev Bras Promoc Saude* 2013; 26(3):404-411.
20. Torres JL, Ordóñez JG, Vázquez-Martínez MG. Conocimientos, actitudes y prácticas sobre el dengue en las escuelas primarias de Tapachula, Chiapas, México. *Rev Panam Salud Publica* 2014; 35(3):214-218.
21. Arunachalam N, Tyagi BK, Samuel M, Krishnamoorthi R, Manavalan R, Tewari SC, Ashokkumar V, Kroeger A, Sommerfeld J, Petzold M. Community-based control of *Aedes aegypti* by adoption of eco-health methods in Chennai City, India. *Pathogens Glob Health* 2012; 106(8):488-496.
22. Caprara A, Lima JWO, Peixoto ACR, Motta CMV, Nobre JMS, Sommerfeld J, Kroeger A. Entomological impact and social participation in dengue control: a cluster randomized trial in Fortaleza, Brazil. *Trans R Soc Trop Med Hyg* 2015; 109:99-105.
23. Costa MMC, Barbosa MJP, Freitas VC, Albuquerque PC. Amigos do bairro contra dengue: a experiência do distrito sanitário da III secretaria de saúde do Recife, implantação de um projeto de participação popular em saúde. *Rev APS* 2012; 15(4):517-521.
24. Healy K, Hamilton G, Crepeau T, Healy S, Unlu I, Farajollahi A, Fonseca D. Integrating the Public in Mosquito Management: Active Education by Community Peers Can Lead to Significant Reduction in Peridomestic Container Mosquito Habitats. *PLoS One* 2014; 9:e108504.
25. Kittayapong P, Thongyuan S, Olanratmanee P, Aumchareoun W, Koyadun S, Kittayapong R, Butraporn P. Application of eco-friendly tools and eco-biosocial strategies to control dengue vectors in urban and peri-urban settings in Thailand. *Pathogens Glob Health* 2012; 106(8):446-454.
26. Mitchell-Foster K, Ayala EB, Breilh J, Spiegel J, Wilches AA, Leon TO, Delgado JA. Integrating participatory Community mobilization processes to improve dengue prevention: an eco-bio-social scaling up of local success in Machala, Ecuador. *Trans R Soc Trop Med Hyg* 2015; 109:126-133.
27. Ghosh SK, Chakaravarthy P, Panch SR, Krishnappa P, Tiwari S, Ojha VP, Manjushree R, Dash AP. Comparative efficacy of two poeciliid fish in indoor cement tanks against chikungunya vector Aedes aegypti in villages in Karnataka, India. *BMC Public Health* 2011; 11:599.
28. Nam VS, Yen NT, Duc HM, Tu TC, Thang VT, Le NH, San LH, Loan LL, Huong VTQ, Khanh LHK, Trang HTT, Lam LZY, Kutcher SC, Aaskov JG, Jeffery JAL, Ryan PA, Kay BH. Community-Based Control of Aedes aegypti By Using Mesocyclops in Southern Vietnam. *Am J Trop Med Hyg* 2012; 86(5):850-859.
29. Paiva CN, Lima JW, Camelo SS, Lima CF, Cavalcanti LP. Survival of larvivorous fish used for biological control of Aedes aegypti (Diptera: Culicidae) combined with different larvicides. *Trop Med Int Health* 2014; 19(9):1082-1086.
30. Possas C. Zika: what we do and do not know based on the experiences of Brazil. *Epidemiol Health* 2016; 38:e2016023.

Article submitted 22/06/2018
Approved 06/11/2020
Final version submitted 08/11/2020

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva