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SUSTAINABILITY IN EDUCATION AND ENVIRONMENTAL HEALTH TO PREVENT *Aedes spp*: A LITERATURE REVIEW

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ABSTRACT

Objective: Determine the state of knowledge in sustainable strategies used in health and environmental education to prevent the proliferation of the mosquito and vector of viral diseases, *Aedes spp*.

Theoretical Framework: Concepts about the proliferation of the habitat of *Aedes spp* are addressed. mosquito that causes diseases such as dengue, Zika, chikunguya and yellow fever in various regions of the planet.

Method: The PRISMA method was used, the words "environmental health" AND/OR "environmental education" AND/OR "environmental literacy" AND/OR "dengue" AND/OR "Aedes spp" were entered on the PubMed, Sciences Direct, Scopus and Virtual Health Library databases.

Results and Discussion: One hundred and twelve documents were identified, out of which 65 articles were selected from 2008 to 2022 with the established level of suitability and classified into four areas: studies aimed at the community, research groups and government entities, studies related to the mosquito, and studies on uses of georeferencing as a tool. 20.8% of the literature reviews are from North America, 19.4% of the studies conducted in communities are from Latin America, and georeferencing studies begin to be evidenced from 2015.

Research Implications: The ideal method to evaluate and apply sustainable strategies in communities is the cluster-randomized controlled trial. It is important to continue studying the behavior of the mosquito and the climatic, chemical, and biological factors that affect it, and using georeferencing tools to expand knowledge of the behavior of the mosquito in communities in terms of geographical distribution to create proliferation monitoring and prevention strategies.

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Originality/Value: The added value of the study is to address the health implications of climate change and how communities face the problem to prevent the introduction and proliferation of the mosquito without affecting the environment.

Keywords: Aedes, Environmental Health Education, Vector-Borne Diseases, Waste Management, Climate Change, Dengue.

SUSTENTABILIDADE NA EDUCAÇÃO E SAÚDE AMBIENTAL PARA PREVENIR Aedes spp: UMA REVISÃO DA LITERATURA

RESUMO

Objetivo: Determinar o estado do conhecimento em estratégias sustentáveis utilizadas na educação sanitária e ambiental para prevenir a proliferação do mosquito e vetor de doenças virais, Aedes spp.

Estrutura Teórica: São abordados conceitos sobre a proliferação de hábitats do mosquito Aedes spp que causa doenças como dengue, zika, chikunguya e febre amarela em várias regiões do planeta.

Método: O método PRISMA foi utilizado, as palavras "saúde ambiental" e / ou "educação ambiental" e / ou "alfabetização ambiental" e / ou "dengue" e / ou "Aedes spp" foram inseridas em PubMed, Sciences Direct, Scopus e bancos de dados Biblioteca Virtual em Saúde.

Resultados e Discussão: Foram identificados 122 documentos, dos quais 65 artigos selecionados entre 2008 e 2022 com nível de adequação estabelecido e classificado em quatro áreas: estudos direcionados à comunidade, grupos de pesquisa e órgãos governamentais, estudos relacionados ao mosquito e Estudos sobre usos da georeferenciação como ferramenta. 20,8% das resenhas de literatura são da América do Norte, 19,4% dos estudos realizados em comunidades são da América Latina e os estudos de georeferenciamento começam a ficar evidentes a partir de 2015.

Implicações da pesquisa: O método ideal para avaliar e implementar estratégias sustentáveis em comunidades é o ensaio controlado aleatório por grupos. É importante continuar estudando o comportamento do mosquito e os fatores climáticos, químicos e biológicos que o afetam, e usar ferramentas de georreferenciamento para ampliar o conhecimento do comportamento do mosquito nas comunidades em termos de distribuição geográfica a fim de criar monitoramento e prevenção de sua proliferação.

Originalidade/valor: O valor agregado do estudo é abordar as implicações das mudanças climáticas na saúde e como as comunidades lidam com o problema para evitar a introdução e proliferação do mosquito sem afetar o meio ambiente.

Palavras-chave: Aedes, Educação Ambiental em Saúde, Doenças Transmitidas por Vetor, Gestão de Resíduos, Mudanças Climáticas, Dengue.

SOSTENIBILIDAD EN EDUCACIÓN Y SALUD AMBIENTAL PARA PREVENIR *Aedes spp*: UNA REVISIÓN DE LA LITERATURA

RESUMEN

Objetivo: Determinar el estado del conocimiento en estrategias sustentables utilizadas en salud y educación ambiental para prevenir la proliferación del mosquito y vector de enfermedades virales, *Aedes spp*.

Marco Teórico: Se abordan conceptos sobre la proliferación del hábitat de *Aedes spp* mosquito causante de enfermedades como el dengue, Zika, chikunguya y fiebre amarilla en diversas regiones del planeta.

Método: Se utilizó el método PRISMA, se ingresaron las palabras “salud ambiental” Y/O “educación ambiental” Y/O “alfabetización ambiental” Y/O “dengue” Y/O “Aedes spp” en PubMed, Sciences Direct, Scopus y Bases de datos de la Biblioteca Virtual en Salud.

Resultados y Discusión: Se identificaron ciento doce documentos, de los cuales se seleccionaron 65 artículos del 2008 al 2022 con el nivel de idoneidad establecido y clasificados en cuatro áreas: estudios dirigidos a la comunidad, grupos de investigación y entidades gubernamentales, estudios relacionados con el mosquito y Estudios sobre usos de la georreferenciación como herramienta. El 20,8% de las revisiones de literatura son de América del Norte, el 19,4% de los estudios realizados en comunidades son de América Latina y los estudios de georreferenciación comienzan a evidenciarse a partir de 2015.

Implicaciones de la investigación: El método ideal para evaluar y aplicar estrategias sostenibles en las comunidades es el ensayo controlado aleatorio por grupos. Es importante continuar estudiando el comportamiento del mosquito y los factores climáticos, químicos y biológicos que lo afectan, y utilizar herramientas de georreferenciación para ampliar el conocimiento del comportamiento del mosquito en las comunidades en términos de distribución geográfica para crear monitoreo y prevención de su proliferación. estrategias.

Originalidad/Valor: El valor agregado del estudio es abordar las implicaciones del cambio climático para la salud y cómo las comunidades enfrentan el problema para prevenir la introducción y proliferación del mosquito sin afectar el medio ambiente.

Palabras clave: Aedes, Educación en Salud Ambiental, Enfermedades Transmitidas por Vectores, Gestión de Residuos, Cambio Climático, Dengue.

1 INTRODUCTION

Environmental pollution can result in diseases, which manifest themselves unequally in the population; The hardest hit are those minority and low-income communities that are usually more exposed to areas with air and water pollution and poor waste management. Added to this are other social determinants of health, such as the lack of literacy in environmental health, which exacerbate the problem.

It is therefore necessary to address the issue of environmental pollution in a way that is committed to community members and at various levels in which communities can participate; either by disseminating information from one person to another, or through their social leaders, taking into account that the construction of knowledge varies from one population to another. In this sense, traditional pedagogical models may not be effective and it is necessary to establish a more empathetic and credible relationship, thus improving the transfer of knowledge (Balcazar et al., 2016).

In 1967, the Commission on Environmental Health was created, which in a document allows us to discern concern about the potential dangers resulting from the already increasing chemical, radiological and water contamination as a consequence of modern scientific and technological development (Anderson, 1967). the use of agricultural chemicals, as well as public policies that at the time had not been given the necessary attention, and there is already

talk of a takeover by public health for those aspects of the environment that are actually and potentially harmful to human health and life. In turn, he urges that the health authorities be the ones to enforce the rules that are essential for the protection of health.

The objective of this systematic review is to determine the state of knowledge in sustainable strategies used in health and environmental education to prevent the proliferation of the mosquito and vector of viral diseases, *Aedes spp*, from the perspective of different research approaches to review their effectiveness and possible replication in future research, and to detect unresolved problems and/or research needs.

2 THEORETICAL FRAMEWORK

2.1 ENVIRONMENTAL MANAGEMENT STRATEGIES TO PREVENT *AEDES SPP*

Aedes aegypti is an invasive mosquito with a long history of transmission of arboviruses, which cause diseases such as yellow fever, dengue, zika, and chikunguya (Gloria-Soria et al., 2022; Macêdo et al., 2021; Nunes et al., 2021). Their spread has been increasing due to climate change events such as El Niño-Southern Oscillation, rainfall, hurricane season and the monsoon in Asia, affecting natural ecosystems and the increase of heat islands in urban environments and megacities in times of drought or heatwaves (Desjardins et al., 2020; French et al., 2021; Gallo et al., 2020; Lowe et al., 2019; Oo et al., 2011; Seger, 2019; Syal et al., 2011; Varela et al., 2019; Tapia-Conyer et al., 2012).

The accumulation of water and other practices such as single-use plastics, gardens and garages, greenhouses, septic tanks, and large-scale international travel, together with industrial and commercial urban decay, favor the habitats for the reproduction of the mosquitoes and its dispersion (Gallo et al., 2020, Krystosik et al., 2020; Gloria-Soria et al., 2022). The children population from less favored socioeconomic strata are the most affected (Lawler & Patel, 2012; Bernasconi et al., 2021).

Environmental management strategies aimed at improving community participation in the elimination of Aedes aegypti breeding sites make it possible to prevent vector-borne diseases by improving knowledge (Sánchez et al., 2018; Vanlerberghe et al., 2009), attitudes, and practices, which in turn are supported by the emergence of currents such as Ecosystem Health, Conservation Medicine, EcoHealth, and One Health that encourage the multicultural and multidisciplinary contribution of ethical and ecologically sustainable solutions ranging from education (de Moura et al., 2022; Kevany et al., 2013; Maeda et al., 2018; Rahman et al.,

2021ab; Ruggerio et al., 2021), health, informal recycling, environmental scientist and geographers to economics, politics, and religion (Aguirre et al., 2019; Ezeah et al., 2013; Hathaway & Maibach, 2018; Hernandez-Suarez & Mendoza-Cano, 2016; Liang et al., 2018; Santos et al., 2022).

3 METHODOLOGY

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement was taken as a methodological reference for the documentation of systematic reviews (Page et al., 2020). The process is represented in Figure 1 and was developed as follows:

a. The first stage of Document Identification was carried out by searching the PubMed, Science Direct, Scopus and Virtual Health Library (VHL) databases using the combination of terms:

- "environmental health" AND "environmental education",
- "environmental health" AND "environmental education" AND "Aedes aegypti"
- "environmental health literacy" AND "Aedes aegypti"
- "environmental health literacy" AND "dengue"

One hundred and twelve documents published in the period 2008-2022 were found in English, Spanish or Portuguese. The documents correspond to books, book chapters, conferences, debates, undergraduate thesis, and letters to the editor. There was no exclusion by geographical boundaries.

b. In the Selection stage, 17 documents did not meet the criterion of original article or systematic review, and 30 documents were repeated and/or full text was not available, thus yielding 65 articles.

c. The Suitability stage of the articles included a thorough reading of each document and entry into an Excel database. It allowed us to organize information related to health, education, policies, communication, economics, waste, anthropogenic behaviors, climate change, chemical and biological control, philosophy and thought.

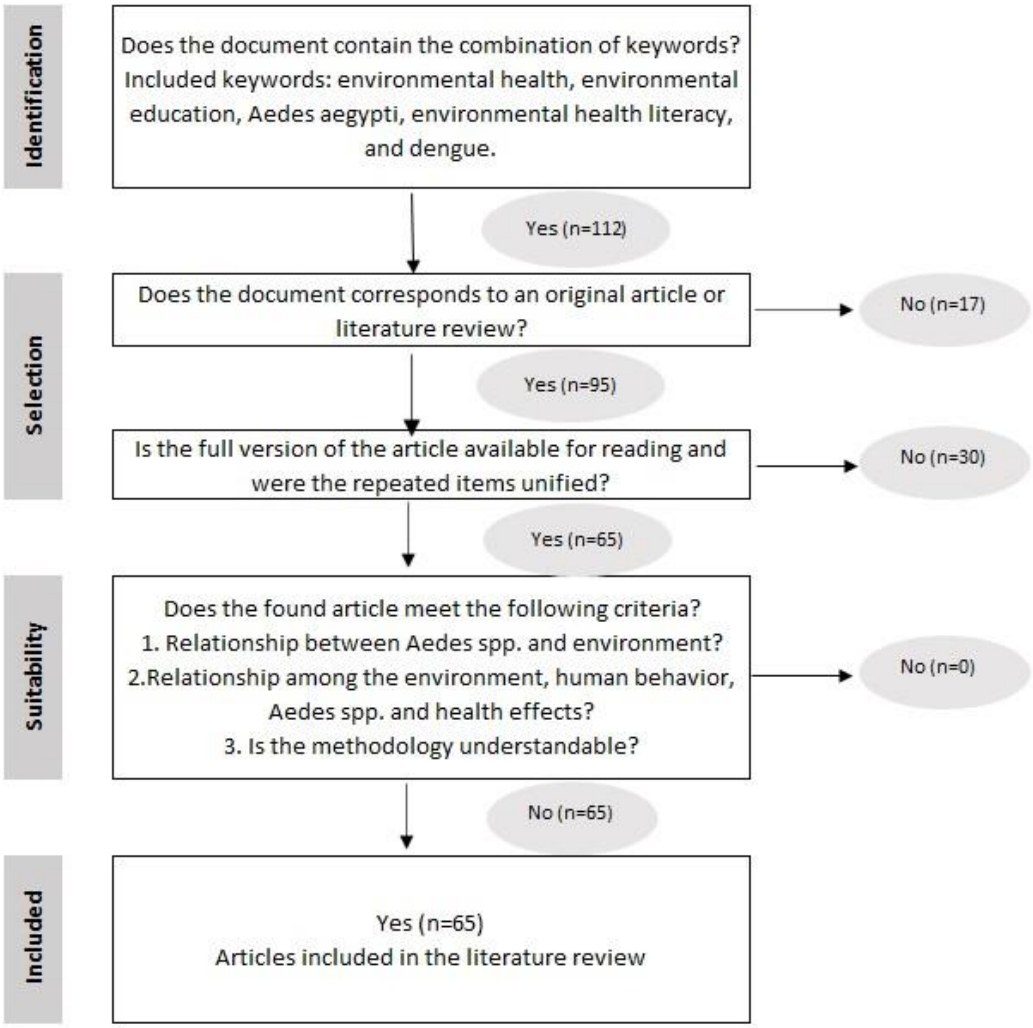
d. Finally, a total of 65 articles that met the criteria established for the systematic review were Included.

Once the original articles were selected for systematic review, they were classified into community-based studies, studies aimed at research groups and/or government entities, studies on mosquitoes, and studies using georeferencing as a tool. The literature review and/or

systematic articles dealt with various topics including waste, climate change, and the effect on health events, uses of tools such as Google Earth and map design.

Figure 1

Application of the PRISMA Method for the identification, selection, suitability and inclusion of articles.

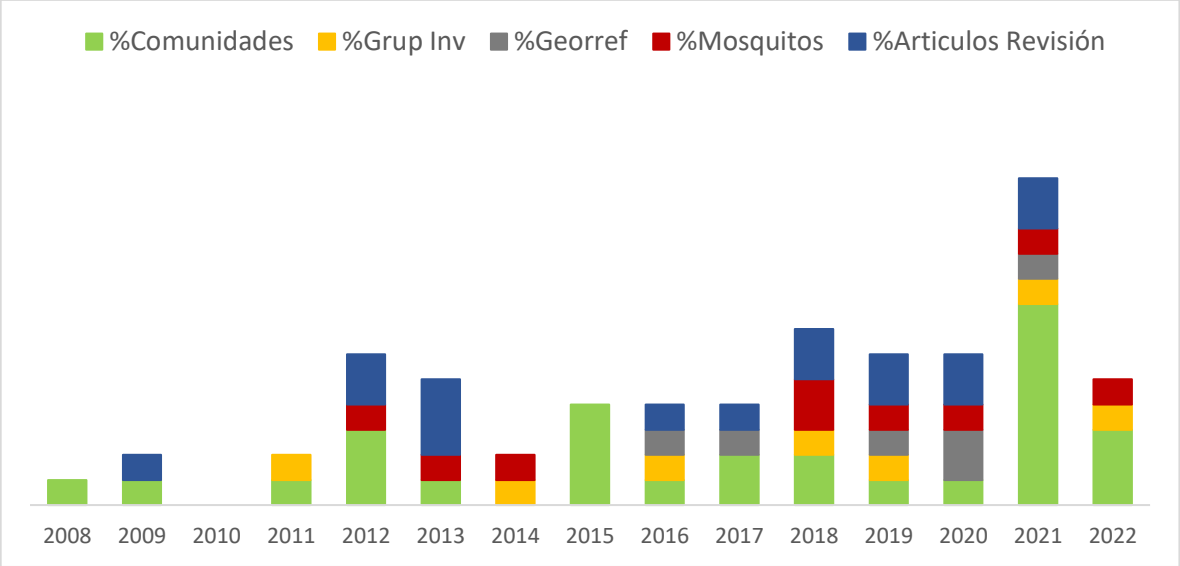


4 RESULTS AND DISCUSSION

Of the selected articles, 20.0% were published in 2021 with a large participation of community studies (12.3%). During 2015, all the articles selected were related to communities; 24.6% correspond to systematic reviews and 13.8% to studies about mosquitoes in the other years. Since 2015, 9.2% of the studies have to do with georeferencing, and 10.8% of the publications were applied by research groups or government agencies. See Figure 2.

Figure 2

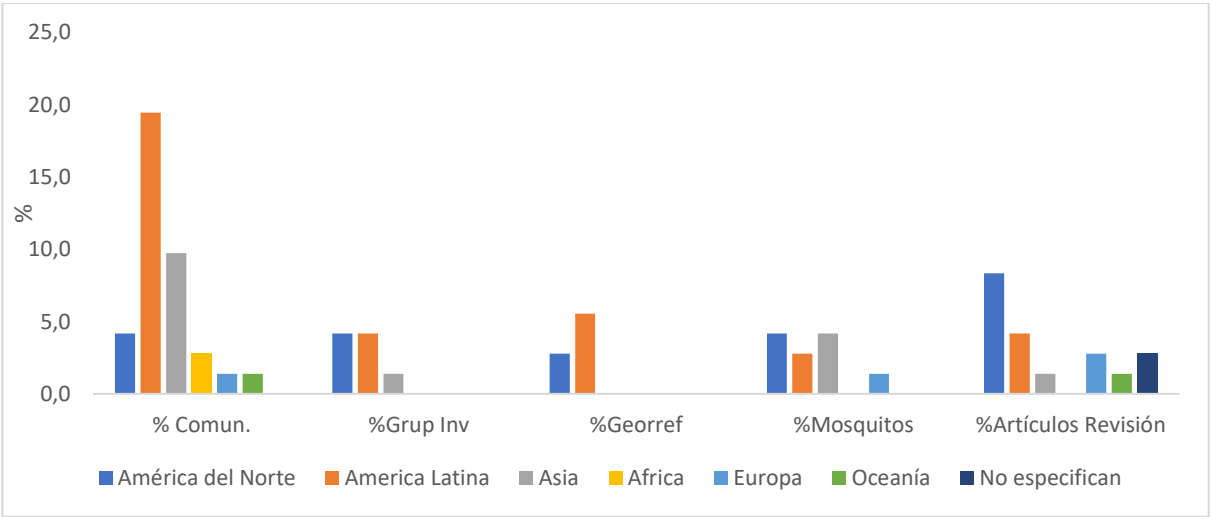
Evolution of articles by topic during the years 2008-2022



Out of the studies carried out in Latin America, 19.4% are conducted in communities, while 4.2% correspond to research groups or government entities. As of 2015, the studies that use georeferencing as a tool are in the order of 2.8% in North America and 5.6% in Latin America, as shown in Figure 3.

Figure 3

Original and literature review articles classified according to topic and region



1. Findings of studies conducted in community settings

a. Descriptive studies were carried out in large areas (cities or municipalities) and studies in households or units of houses (traditional constructions, bungalows, illegal settlements) in urban and rural areas, including diagnostic images, laboratory tests, medical histories or clinical records, and indicators of animal, environmental, and human health (Banerjee et al., 2015; French et al., 2021; Gallo, et al., 2020; Nunes et al., 2021; Oo et al., 2011; Sánchez-Gervacio et al., 2021; Rahman et al., 2021a; Teixeira, 2015; Thompson et al., 2012; Vanlerberghe et al., 2009; Whiteman et al., 2018; Xavier et al., 2013).

b. Perception studies were carried out in women's communities, educational communities, and health professionals, especially on good environmental management practices (de Moura et al., 2022; Hernandez-Suarez & Mendoza-Cano, 2016; Jankowska et al., 2013; Lucarelli et al., 2020; Pascawati et al., 2021; Surata & Vipriyanti, 2018).

c. Studies that allow correlating diseases with climatic factors were conducted in different population groups; between mosquito infestation and social and health indicators; and society/university/state interaction with education and dissemination campaigns (Lawler & Patel, 2012; Nunes et al., 2021; Ruggerio et al., 2021; Teixeira, 2015; Thompson et al., 2012).

d. Randomized controlled trials have been applied to compare and evaluate community-based environmental management strategies, community environmental education and intervention strategies such as EcoBioSocial (EBS). They have been previously implemented as observed in the RISE program, in which infrastructure was delivered in informal settlements (Arunachalam et al., 2012; Ávila et al., 2012; Caprara et al., 2015; French et al., 2021; Kalyanasundaram et al., 2021; Macêdo et al., 2021; Sánchez-Gervacio et al., 2021; Vanlerberghe et al., 2009).

The survey was the most used tool for information collection and indicators of social, economic, environmental, entomological, education, health, housing, safety, transport, level of knowledge, perception, commitment, attitudes and practices determinants were verified. Examples of surveys include the Community Assessment for Public Health Emergency Response (CASPER) (Macêdo et al., 2021; Nunes et al., 2021; Oo et al., 2011; Rahman et al., 2021a; Seger, 2019; Soh et al., 2021; Thompson et al., 2012; Vanlerberghe et al., 2009; Veiga et al., 2016; Whiteman et al, 2018).

Climatic variables and/or meteorological factors such as day/ night temperature, humidity, wind, average annual rainfall, drought index, evapotranspiration and soil moisture (Sallam et al., 2017; Rocque et al., 2021), drinking water environmental indicators, proximity

to landfill, access to sewage, presence of plants, water tank and garden (Nunes et al., 2021; Santos et al., 2022), attitudes and behaviors, environmental health indicators, animal health indicators, and ecological variables were analyzed de (Moura et al., 2022). Sustainability indicators were evaluated to determine the need to include or exclude existing ones (Veiga et al., 2016).

2. The studies aimed at research groups and/or government entities evidenced different objectives like the perception of One Health knowledge barriers in Latin American countries (Cediel et al., 2021 et al., 2021), sustainability indicators in health for the management of urban solid waste (Veiga et al., 2016), vulnerabilities in the children population derived from climate change to create policies(Lawler & Patel, 2012) making activities related to public and environmental health by local and state directors predicting the impacts on climate-related health(Syal et al., 2011), members and researchers of a Mosquito Stoppers Civic Ecology Practices (MS-CEP) to promote learning about waste management (Jordan et al., 2019), using the methodology of diffuse multi-attribute decision approaches for modeling epidemic antecedents among computer science and epidemiology specialists to verify social, institutional, environmental and economic antecedents (Abellana, 2021), and assessing insecticide susceptibility in *Aedes spp* specimens from 25 districts of mosquito reduction programs collected previously by government agencies and universities (Richards et al., 2018).
3. The use of georeferencing studies corresponds to determining the correlation between any of the stages of the mosquito life cycle and socioeconomic, environmental, climatic variables and dengue outbreaks in different sectors and time periods (Desjardins et al., 2020; Ruggerio et al., 2021) to predict the geographical distribution of dengue or *Aedes spp* mosquito and the combination with future climatic conditions and urban growth (Kraemer et al., 2019), establish mitigation and prevention measures (Gallo et al., 2020), determine perceived and manifested risk factors through narratives, and associate it with the neighborhoods mapping (Krystosik et al., 2017), and apply a geospatial curricular learning design using Web GIS to understand patterns of the disease in public health students (Reed & Bodzin, 2016).
4. Studies related to the *Aedes spp.* mosquito involved collecting samples *in vivo* (Richards et al., 2012) and *in* vitro (Lin et al., 2021) to determine the state of susceptibility to insecticides such as pyrimiphos-methyl, cypermethrin, and other chemicals (Lee et al., 2014; Kramer et al., 2020).

The mechanism of mosquito introduction in the states of Nebraska and Utah (Gloria-Soria, et al., 2022), the interaction of the latter in cold climates (Kramer et al., 2020) by increasing the temperature (Dávalos-Becerril et al., 2019) and the ability to reproduce in different materials, especially domestic waste (Banerjee et al., 2013), were determined.

The analysis of entomological indices classified by measurement areas such as container, household, and individuals was used to determine the effect of educational interventions (Ávila et al., 2012) and evaluate biological control measures such as the use of guppy fish (*Poecilia reticulata*) and platy fish (*Xiphoporus maculatus*) (de Campos Júnior et al., 2018), as evidenced in Table 1. It also evaluates the behavior of the indices during rainy, dry, cold, and hot seasons (Oo et al., 2011) and correlates it with socioeconomic conditions (Rahman et al., 2021b).

Table 1

Aedical indices used by the different authors to evaluate the entomological situation

Entomological indices according to the measurement area	**Rec.**	**Households**						**Pers.**
Author	**R**	**IO**	**IV**	**IB**	**HI**	**IDA**	**ICI**	**PPI**
Ballenger-	x		x	x	x	x	x	x
Oo et al., 2011				x				
Banerjee et al.,				x				
Caprara et al.,	x			x	x	x		x
Krystosik et al.,				x				
Jordan et al.,			x				x	
French et								
Nunes et al., 2021				x				
Ruggerio et al.,			x					
Pascawati et al.,	x				x	x		
Rahman,	x						x	

IR or Index of positive Containers for larvae=No of Containers (+ for larvae) /Total of containers
IO or Ovitrap Positive Index = No Eggs per Ovitrap/No Ovitrap Households
IV o Positive Households Index =No of households positive for larvae /Total households
IB or Breteau Index = No of positive containers for larvae per 100 inspected households
HI or Household Index = Number of households positive for larvae per 100 houses.
IDA or Adult Density Index =No female adults per household
ICI or Indoor Capture Index =No female adults per person-hour
PPI or Pupa INDEX per person= No of Pupas per inhabitant
Rec. or Container
Pers. or Person

The ecophysiological capacity and diapause of the Aedes spp mosquito generates resistance in the eggs (Kraemer et al., 2019), Aedes albopictus adapts better to the natural

environments created by man and climatic factors (Banerjee et al., 2013; Lowe et al., 2019; Walther et al., 2016), for instance, a diurnal surface temperature of 26 °C with a fluctuation of 7.6 °C and relative humidity of 66%; furthermore (Desjardins et al., 2020; Gallo et al., 2020; Taborda et al., 2022), a 100% increase in diseases explained by the alteration of climatic parameters has been demonstrated (Reyes Vásquez et al., 2021; Thompson et al., 2012).

Focusing on the prevention of the spread and establishment of the mosquito due to anthropogenic activities through epidemiological surveillance and rapid response protocols for vector control including ports and roads (Oo, et al., 2011), pilgrimages, and tourism helps strengthening health planning by communities and reducing socioeconomic and environmental inequality in the face of infectious diseases associated with low priority in public policies and little attention from governments (Dávalos-Becerril et al., 2019; Gloria-Soria et al., 2022; Jankowska et al., 2015; Santos et al., 2022). Dengue has been classified by the World Health Organization-WHO as the most important viral disease transmitted by a mosquito in the world (Ruggerio et al., 2021), children being the most affected population (Bernasconi et al., 2021; Lawler & Patel, 2012).

Accumulative practices, vacant lots, failures in the management of water (Chiodi & Machado, 2023; Hernandez-Suarez & Mendoza-Cano, 2016; Sánchez-Gervacio et al., 2021), waste, and deforestation require behavior changes through educational activities directly with the community to help improve their attitude, e.g., the Eco-BioSocial strategy (Banerjee, et al., 2013; Caprara et al., 2015; Macêdo et al., 2021; Sánchez-Gervacio et al., 2021), changing norms and behaviors, creating sustainable habits through simple activities such as emptying, sealing, and protecting tanks, cleaning buckets and drinking troughs, as well as waste management are fundamental to eliminate hatcheries (Banerjee et al., 2013; Fernandez & Naveda, 2023; Krystosik et al., 2020; Kalyanasundaram et al., 2021; Lowe et al., 2019; Santos Leite et al., 2023; Vanlerberghe et al., 2009). All this through a systemic community approach including heads of families, women's associations (Jankowska, et al., 2015) that in turn are heads of household (Kevany et al., 2013), interdisciplinary work between school teachers, primary and secondary students (de Moura et al., 2022; Macêdo et al., 2021), school workers (concierges) (Hernandez-Suarez & Mendoza-Cano, 2016), health providers and medical professionals specialized in pediatrics that play an important role in the protection of the children population, who are more vulnerable (Bernasconi et al., 2021).

Likewise, intersectoral work by including public sectors and civil society (Ávila et al., 2012). All of the above, considering that active community intervention and education demonstrates a significant decrease in the mosquito population (Desjardins et al., 2020; Oo et

al., 2011).

Community participation in the generation and application of environmental management strategies accompanied by governance actions, leadership, empowerment, interaction, autonomous decision-making spaces, technical capacity, and political and socio-cultural community participation mechanisms to fight Arbovirus promote sustainable practices and environmental behavior maintained over time (Caprara et al., 2015; Kalyanasundaram et al., 2021; Macêdo et al., 2021; Ruggerio et al., 2021; Vanlerberghe et al., 2009), and preserve trust among community stakeholders (Soh et al., 2021). According to experts, these can be measured in case sustainability indicators related to water and waste management for vector control are set out again (Banerjee et al., 2013; Jankowska et al., 2015; Veiga et al., 2016).

Behavioral research was carried out by applying randomized controlled trials by community-based clusters (Vanlerberghe et al., 2009). They have proven to be the most effective methodologies because they are participatory (Sánchez-Gervacio et al., 2021), implement direct dialogue with the community without prejudice and domination, and the cost for the evaluation of large-scale strategies and measuring the impact of acceptance, profitability, and participatory surveillance in the prevention of vector-borne diseases is low.

This is the case of EcoBioSocial strategy (EBS), characterized by direct contact with the community (Caprara, et al., 2015; Macêdo et al., 2021). It focuses on improving knowledge and positive attitude as well as setting out easy behaviors regarding skills, time, and resources (Ruggerio et al., 2018; Pascawati et al., 2021; Seger, 2019), using audiovisual content support such as the "ZIKAMOB" platform (Santos et al., 2022); effective training for concierges days before the start of classes, managing to decrease the infection rate from 1.81 to 0.55 (Hernandez-Suarez et al., 2016); use of media and social networks to inform the public about climate change and its effect on health (Hathaway & Maibach, 2018; Rahman et al., 2021b; Soh et al., 2021) especially teachers of public and private schools, students, health providers, and pediatricians, who play an important role in promoting and preventing health, resilience, and environmental sustainability (Bernasconi et al., 2021).

Measuring self-efficacy to take an action, the perceived responsibility in the behavior, and the ability of family and neighbors to change it (Santos et al., 2022; Syal et al., 2011) are indicators that must be verified when evaluating the effectiveness of the strategy, the profitability of the intervention, the impact of environmental management and sustainability in governance actions applying the Ecosalud principles (Caprara et al., 2015; Macêdo et al., 2021; Pacheco dos Santos et al., 2023).

The eradication of mosquito breeding sites should not generate complex and

contradictory relationships with ecosystem functions and services, as has been observed when draining wetlands (Walthe et al., 2016), and by the inadequate and unsafe management of pesticides in rural and urban areas, which affects populations of arthropods, pollinators, and parasites, thus leading to the extinction of invertebrate fauna in different aquatic and terrestrial ecosystems (Lowe et al., 2011; Oo et al., 2011; Sánchez-Gervacio et al., 2021) —Their prolonged use also generates resistance— (de Campos et al., 2018); and the elimination of plant cover in cities by changing the local pattern of energy and temperature balance, thus generating periods of drought, heat waves, and inadequate water supply (Krystosik et al., 2020).

The search for biological control alternatives for the *Aedes spp* vector (Lowe et al., 2019), such as the use of larvivores like Poecilia reticulata, guppy fish, and Xiphoporus maculatus, platy fish, in lentic and lotic environments (de Campos et al., 2018); larvae of salamanders (Aguirre et al., 2019), and other beneficial arthropods would have a social and economic value because they are beneficial and sustainable for wildlife. However, it requires the participation and generation of research in urban biodiversity, urban planning and ecosystem services involving ecologists, agricultural scientists, ecotoxicologists, public health officials, local government, and natural resource managers (Lowe et al., 2018; Ruggerio et al., 2021; Walther et al., 2016).

Environmental water management based on traditional practices such as subak in Bali, Indonesia (Surata & Vipriyanti, 2018), and Geographic Information Science - GIS technologies in secondary schools, environmental sciences, public health, and geography (Reed & Bodzin, 2016; Ruggerio et al., 2021) enable spatial and temporal epidemiology studies to be correlated with climate dynamics to understand the incidence of the disease and its association with climate change (Desjardins et al., 2020). It also increases local understanding of the relationship between environment and health, especially when people learn about land use, safety, and the limits of spaces through observations and experiences (Ruggerio et al., 2021).

Selecting the most cost-effective alternatives involves adapting community-based approaches to mosquito prevention and control strategies (Krystosik et al., 2017). Intervention methods are the most economical and sustainable over time (Caprara, et al., 2015; Taborda et al. 2022) with a multicultural, multidisciplinary, ethical, and ecologically sustainable contribution, especially by achieving a holistic vision in the prediction, control, and prevention of vector-borne parasitic diseases (Aguirre et al., 2019; de Campos et al., 2018; Kevany et al., 2013). Moreover, to create support networks in education, politics, the environment (Lawler & Patel, 2012) that collect, analyze, and communicate different perspectives (Curtis, 2016) and even lead to the generation of participatory proposals for social transformation by communities

(Sanmartino et al., 2020), as evidenced in the formalization of the recycling sector, thus improving their quality of life, collective recognition, and legitimization (Ezeah et al., 2013).

5 CONCLUSION

Awareness and concern for environmental issues will only be successful when community behaviors and practices are sustainable, effective, low-cost, and sustained over time. Sustainability indicators must be aimed at evaluating the knowledge and training that, for vector control, is related to waste management. It impacts the environment and therefore public health; promoting research into awareness raising on climate change health implications, adaptation measures, and coping mechanisms in communities, as well as strategies for biological control and protection of biodiversity —which prove to be highly sustainable together with their implementation— can prevent the introduction and proliferation of the mosquito without affecting the environment. Education in entomological surveillance requires the support of social media and media to prevent misinformation. Transdisciplinary, intersectoral, and holistic vision strategy to search for different perspectives can lead to health and socio-ecological frameworks and better forecasting to prevent vector-borne diseases.

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