

The Effectiveness of Community-Based Programs in Preventing Dengue: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Background: The aim of this study was to determine the effectiveness of community-based programs in preventing dengue thru systematic review and meta-analysis of randomized control trials.

Methods: All randomized control trials on the evaluation of the effectiveness of community-based programs in dengue prevention were searched on reliable databases (MEDLINE/PubMed, Embase, ClinicalTrials.gov, Google Scholar, etc.). From a total of 32 studies that were identified as of April 2021, there were 11 studies that were included after screening of the titles and abstracts by the review authors. A computer software Revman v.5.4 was used for the statistical analyses needed for the study. All the included studies were encoded in the said software and the effect of the interventions were estimated using odds ratio for the different measurable dengue indices along with an encoded 95% confidence interval.

Results: The community-based programs used in the included studies were generally effective in preventing dengue using House index (OR=0.83 (95% CI=0.70-0.98), p=0.03), Container index (OR=0.61 (95% CI=0.50-0.74), p<0.01) and Breteau index (OR=0.92 (95% CI=0.81-1.04), p=0.18) as the outcome of measure. The subgroup analysis showed that environmental manipulation [(HI: OR=0.59 (95% CI=0.37-0.92), p= 0.02); (CI: OR=0.54 (95% CI=0.20-1.44), p=0.22); (BI: OR=0.58 (95% CI=0.33-0.88), p=0.010)] had a greater effect towards dengue prevention as compared to human behavior alone or in combination with it.

Conclusion: We conclude that environmental management or programs involving community participation is an effective strategy in dengue prevention. Community empowerment and capacity building are indeed important elements to achieve dengue control.

Key words: dengue, environmental management, community-based programs, meta-analysis

INTRODUCTION

Dengue requires community participation to effectively combat the factors that propagate it such as cleanliness, sewerage, household protection and community's knowledge and awareness.³ The community members are educated and encouraged to be proactive in vector control strategies in order to achieve the goal of reducing dengue transmission and infection. Capacity building and empowerment for community members are made essential in the intervention.

An action research design was done in two villages in Kanchanaburi, Thailand to assess the effectiveness of community-based

approach program for prevention and control of dengue hemorrhagic fever. The key community stakeholders in the experimental village were taught with best practices and were monitored monthly. Knowledge, perception, self-efficacy, and larval survey practices in the experimental group were significantly higher than before the experiment, and higher than the comparison group.⁴

The World Health Organization recommended vector control methods in order to control its transmission. However, it was suggested in previous studies that these traditional strategies were not enough to control its spread and that community-based intervention or programs must be incorporated in the strategy in order to successfully control and prevent dengue infection.

This review is deemed important in order to determine the effectiveness of community-based programs in dengue prevention. Furthermore, the information from this review might be useful to

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family and community physicians in their implementation of dengue control programs in the community. The general objective of this systematic review and meta-analysis is to determine the effectiveness of community-based programs in preventing dengue. The specific objective includes acquiring related researches and appraising their validity systematically and objectively for review.

METHODS

A research protocol was submitted to BIHMI ethics board for registration (Protocol number 2021-02-04). An exemption from the ethical review process was requested and was subsequently approved. The review authors searched reference lists of key articles, performed to identify eligible RCTs and supplement the searching. All potential RCTs that evaluated the effectiveness of community-based programs in dengue prevention, with no limitations on the geographical location of studies but published in English language were included. The first search in April 2021 produced a list of 25 articles, shown in Figure 1. After screening of the titles and abstract, there were a total of 15 studies. Cross-checking of references was done; additional seven papers were identified which sums up a total of 22 studies.

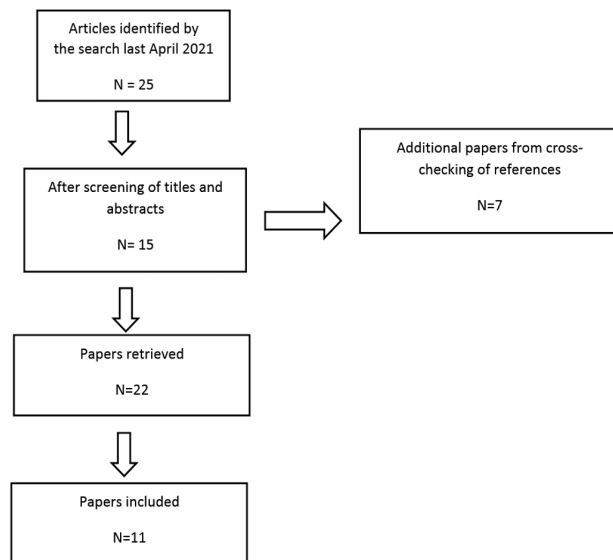


Figure 1. PRISMA diagram of studies reviewed, included and excluded

Selection of Studies

Two review authors independently examined the titles and abstracts of the references and excluded all the obviously non-relevant studies. Subsequently, the screening of the full text articles and identification of studies included were according to the eligibility criteria, documentation of the reasons for exclusion. Resolution of disagreements were done through discussion with a third review author consulted. The selection process and complete Preferred Reporting

Items for Systematic Reviews and Meta-Analyses flow diagram were recorded.

Data Extraction

Two review authors extracted the data and independently completed the data extraction form as seen in Table 1. The data extraction form includes variables as follows:

- Title, author (year) and location.
- Methods: Study design, duration, setting and analysis.
- Types of environmental management interventions: Modification, manipulation or human behavior.
- Outcome measures: Primary outcome is impact on dengue incidence, reported dengue fever, dengue hemorrhagic fever or dengue shock syndrome cases. Secondary outcome is based on impact on entomological indices; Aedes index, House index, Breteau index, Container index and Pupae index.

Risk of Bias Assessment

The quality of the studies was evaluated using Cochrane risk of bias tool. Two independent investigators judged the risk of bias of each trial which were categorized as 'Low', 'Some concerns' or 'High' based on the domains, including bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome and bias in selection of the reported result. Disagreements were resolved by discussion between the two investigators with the third review author called to resolve the disagreement. To address missing data, the authors reviewed the original source of the data in question. They tried to contact the original authors for any clarification on data via e-mail but there was no answer.

Meta- Analysis

The review authors used a computer software Revman v.5.4 as an aid to carry out all the statistical analyses needed for the study. All the included studies were encoded in the said software by providing its study ID. The effect of the intervention in the included studies were estimated using odds ratio for the different measurable dengue indices along with an encoded 95% confidence interval. Risk of bias were taken into account in dealing with the outcome. The generated results were then summarized and interpreted to the readers from which the review authors drew their conclusions.

RESULTS

Table 1 shows details of the 11 CRCTs that met our inclusion criteria for the review published between 1990 and 2020, these studies all implemented interventions and measured impact at the cluster level. Figure 2 shows the risk of bias assessments for the 11 studies. We assessed ten studies as having a low risk of bias overall, the remaining 1 study having an unclear risk of bias mainly because they did not provide enough information to assess some elements of the risk of bias.

Table 1. Interventions and main findings of the 11-cluster randomized controlled included in the systematic review

Study, Year	Title/Author	Location	Study Design	Duration	Intervention	Outcome measures
2020	Effect of an ecosystem- centered community participation program on the incidence of dengue. A field randomized control trial/ Sanchez, et al.	Colima, Mexico	Cluster RCT	2 years	Environmental manipulation and Human Behavior	Incidence of dengue, Risk ratio & Breteau index
2018	Impact of community -based interventions on Aedes aegypti and its spatial distribution in Ouagadougou, Burkina Faso/ Ouedraogo, et al.	Burkina Faso, West Africa	Cluster RCT	12 months	Human Behavior	House index, Container index, Breteau index, Pupae per person index
2015	Evidence based community mobilization for dengue prevention in Nicaragua and Mexico (Camino Verde, the Green Way): cluster randomized controlled trial / Andersson, et al.	Nicaragua and Mexico	Clustered randomized control trial	2 years	Camino Verde (community mobilization/ Human Behavior)	-Relative Risk reduction in serological evidences, self-reported methods cases, House index and Breteau index
2015	Long-lasting insecticide-treated house screens and targeted treatment of productive breeding-sites for dengue vector control in Acapulco, Mexico/ Mendoza, et al.	Acapulco, Mexico	Cluster RCT	2 years	Environmental Manipulation	Pupae index
2015	Entomological impact and social participation in dengue control: a cluster randomized trial in Fortaleza, Brazil / Caprara, et al.	Fortaleza, Brazil	Cluster RCT	1 year	Environmental Manipulation and Human Behavior	House index, Container index, Breteau index, Pupae per person index
2012	Community involvement in dengue vector control: cluster randomized trial/ Vanlergerberhe, et al.	Guantanamo, Cuba	Cluster RCT	1 year	Human Behavior	House index: Breteau index: Pupae index
2012	A community empowerment strategy embedded in a routine dengue vector control programme: a cluster randomized controlled trial/Castro, et al.	La Lisa, Havana City, Cuba	Cluster RCT	3 years	Environmental Manipulation and Human Behavior	Bretau index and relative risk of breteau index
2012	Community-based control of Aedes aegypti by adoption of eco-health methods in Chennai City, India/ Arunachalam, et al.	Chennai City, India	Cluster RCT	1 year and 6 months	Environmental Modification and Human Behavior	Pupae index; House index; Container and Breteau index
2012	Application of eco-friendly tools and eco-bio-social strategies to control dengue vectors in urban and peri-urban settings in Thailand/ Kittayapong, et al.	Chachoengsao, Thailand	Cluster RCT	6 months	Environmental Manipulation and Human Behavior	Pupae index
2006	Effective control of dengue vectors with curtains and water container covers treated with insecticide in Mexico and Venezuela: cluster randomized trials/ Kroeger, et al.	Veracruz (Mexico) and Trujillo (Venezuela)	Cluster RCT	11 months and 10 months	Environmental Manipulation	Breteau index and House index
1998	Effect of a community-based Aedes aegypti control programme on mosquito larval production sites in El Progreso, Honduras/ Leontsini, et al.	El Progreso, Honduras	Cluster RCT	6 months	Environmental Manipulation and Human Behavior	House index and Breteau index

Table 2. Characteristic of excluded studies.

Author/Year/ Study	Reason for exclusion
Shafique, et al./ 2019/Implementation of guppy fish (<i>Poecilia reticulata</i>), and a novel larvicide (Pyriproxyfen) product (Sumilarv 2MR) for dengue control in Cambodia: A qualitative study of acceptability, sustainability and community engagement.	This is a qualitative study which measures the acceptability, sustainability and community engagement with the implementation of guppy fish and a novel larvicide product. No free full text is available.
Liew, et al. / 2019/ Gravid oviposition sticky trap and dengue non-structural 1 antigen test for early surveillance of dengue in multi-story dwellings: study protocol of a cluster randomized controlled trial	This is a study protocol of a cluster randomized trial for gravid oviposition sticky trap and dengue NS1 test for early surveillance of dengue in multi-story dwellings.
Newton-Sánchez, O. A, et al./ 2020/ Effect of an ecosystem-centered community participation program on the incidence of dengue. A field randomized, controlled trial	This study had missing data which we cannot access. No free full text available.
Zinszer K, et al./ 2020/ Sustainable, healthy cities: protocol of a mixed methods evaluation of a cluster randomized controlled trial for <i>Aedes</i> control in Brazil using a community mobilization approach	This is a study protocol of cluster randomized trial of mixed method evaluation for <i>Aedes</i> control in Brazil using a community mobilization approach.
Basso, et al./2017/ Scaling Up of an Innovative Intervention to Reduce Risk of Dengue, Chikungunya, and Zika Transmission in Uruguay in the Framework of an Intersectoral Approach with and without Community Participation	This is a study that looked into interventions not specific to community participation programs.
Mitchell- Foster, et al./ 2015/ Integrating participatory community mobilization processes to improve dengue prevention: an eco-bio-social scaling up of local success in Machala, Ecuador	There are missing data that cannot be accessed.
Abeyewickreme, et al./ 2012/ Community mobilization and household level waste management for dengue vector control in Gampaha district of Sri Lanka; an intervention study	This objectives of the study is to look into waste management for dengue control
Susilowati Tana, et al./ 2012/ Building and analyzing an innovative community-centered dengue-ecosystem management intervention in Yogyakarta, Indonesia	The study only described the entomological surveys as baseline. The focus is more on developing an intervention.
Khin Thet Wai, et al./ 2012/ Community-centred eco-bio-social approach to control dengue vectors: an intervention study from Myanmar	The study's aim is to build up and analyze the feasibility, process, and effectiveness of a partnership-driven ecosystem management intervention in reducing dengue vectors.
Espino, et al./ 2012/ Community-based dengue vector control: experiences in behavior change in Metropolitan Manila, Philippines	The study focused more on the examination of the responses of the communities through introduction of water container management to control dengue vectors
Espinoza-Gomez, et al./ 2002/ Educational campaign versus malathion spraying for the control of <i>Aedes aegypti</i> in Colima, Mexico	The study evaluated the effect of an educational campaign for reducing the breeding places of <i>Aedes aegypti</i> .

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Abeyewickreme et al 2012	+	+	-	+	?	+	+
Andersson et al 2015	+	+	+	?	-	-	+
Arunachalam et al 2012	+	?	-	-	+	+	+
Basso et al 2017	+	-	-	-	?	+	+
Caprara et al 2015	+	+	-	?	-	+	+
Castro et al 2012	+	+	-	-	+	+	+
Khin Thet Wai et al 2013	-	+	?	-	+	+	+
Kittayapong et al 2012	?	-	-	-	+	+	+
Kroeger et al 2006	+	+	-	-	+	+	+
Leontsini et al 1998	-	-	-	?	+	+	-
Mendoza et al 2015	+	?	-	?	?	-	+
Mitchell-Foster 2015	+	+	+	?	+	+	+
Samiratou Ouédraogo et al	+	+	-	+	+	+	+
Sanchez et.al 2020	+	?	?	+	+	+	+
Susilowati Tana et al 2012	+	+	?	-	-	+	+
Vanlerberghe et al 2009	+	?	-	+	?	+	+

Figure 2. Risk of bias assessment using Cochrane method.

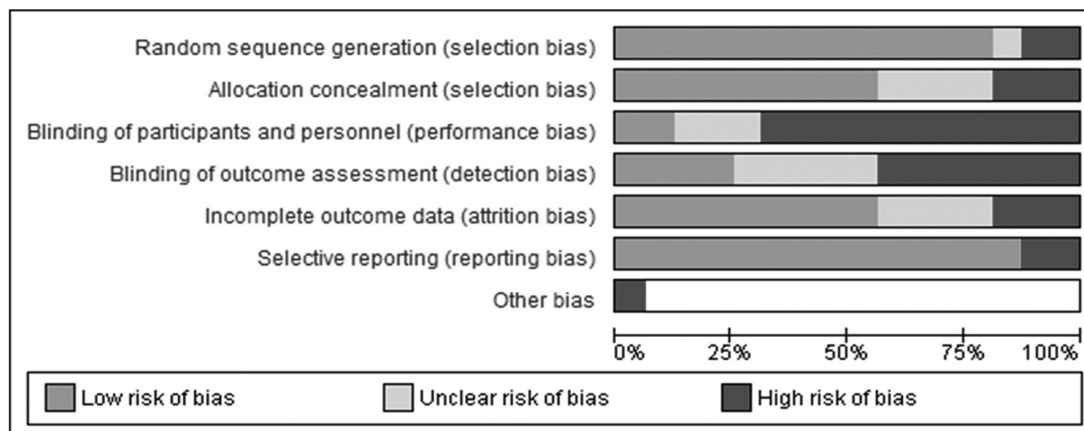


Figure 3. Risk of bias graph

A. House Index

This is the meta-analysis of the House Index performance among several studies which concentrates on different interventions for controlling dengue mosquitos. In interpreting the House index, lesser percentage of houses positive with the larva means lesser incidence of dengue. Consequently, this means the more effective the intervention used. In this case, there are seven (7) out of the eleven (11) included studies considered. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 13.11$ ($p=0.04$) with associated $I^2=54\%$ shows that there is a moderate heterogeneity in the results of the study. Furthermore, in the figure, it is seen that the odds of success are lower as seen in the direction of the individual plots. The overall summarized odds of success of the intervention has an $OR=0.83$ (95% $CI=0.70-0.98$) suggesting the effectiveness of the intervention used to the outcome. The Odds Ratio also has an associated overall effect $Z=2.23$ ($p=0.03$) indicative that the effects are significant at 5% level of significance

B. Container Index

A meta-analysis was also done for Container Index performance of the several studies to evaluate the effectiveness of the interventions for controlling dengue mosquitos. Container index result can be interpreted as, the lesser the percentage of water-holding containers infested with larva, the lesser the incidence of dengue. Consequently, this means the more effective the intervention used. In this case, there are also seven (7) studies considered. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 32.38$ ($p<0.01$) with associated $I^2=81\%$ which shows that there is a substantial heterogeneity in the results of the study. Furthermore, it is seen that the odds of good container index scores are lower among most of the studies as seen in the direction of the individual plots. The overall summarized odds of success of the intervention has an $OR=0.61$ (95% $CI=0.50-0.74$) suggesting the effectiveness of the intervention to the outcome. The Odds Ratio also has an associated overall effect $Z=5.04$ ($p<0.01$) indicative that the effects are significant at 5% level of significance.

A. House Index

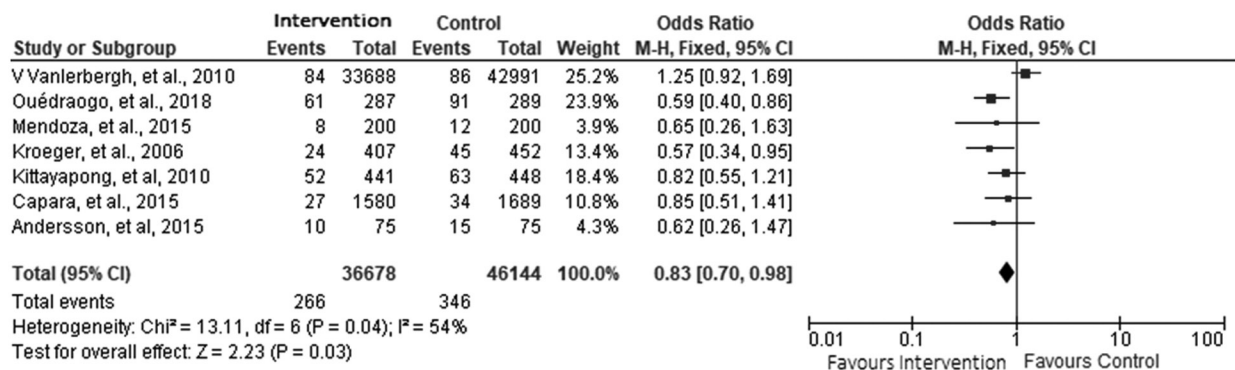


Figure 2. Forest plot of House Index performance among included studies.

B. Container Index

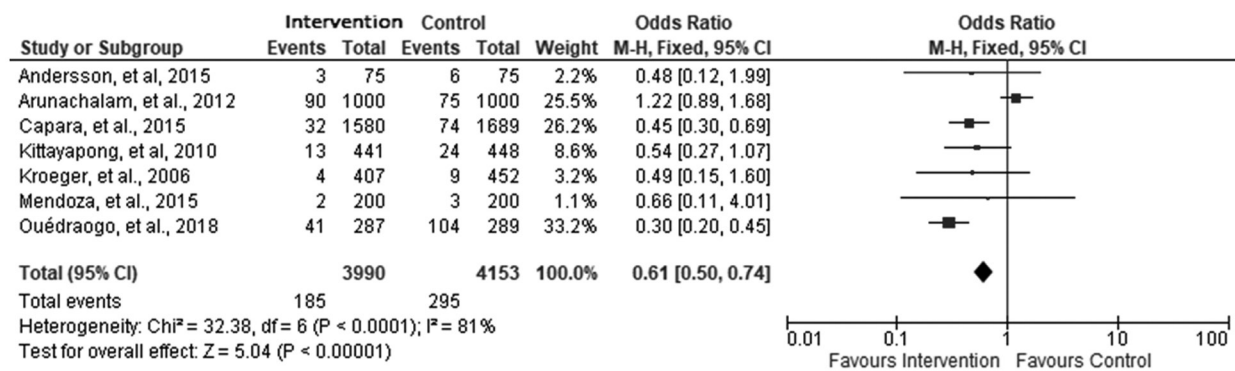


Figure 3. Forest plot of Container Index performance among included studies.

C. Breteau Index

A meta-analysis was also done for Breteau index performance of the several studies to evaluate the effectiveness of the interventions for controlling dengue mosquitoes. In interpreting Breteau index, the lesser number of positive containers per 100 houses inspected, the lesser the incidence of dengue. Consequently, the more effective the intervention used. In this case, there are ten (10) studies considered. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2=733.38$ ($p<0.01$) with associated $I^2=88\%$ which shows that there is a substantial heterogeneity in the results of the study. Furthermore, it is seen that the odds of good Breteau index scores are dispersed in terms of odds of success among the studies as seen in the direction of the individual plots. The overall summarized odds of success has an OR=0.92 (95% CI=0.81-1.04) suggesting an equivocal effect. The Odds Ratio also has an associated overall effect $Z=1.33$ ($p=0.18$) indicative that the effects are not statistically significant at 5% level of significance.

Subgroup Analysis

As stated previously, due to moderate to substantial heterogeneity among included studies, a subgroup analysis was

conducted to identify the source of the heterogeneity. In this study, a subgroup analysis on the different interventions used namely: environmental modification, environmental manipulation and human behavior was done. A detailed description of the different interventions is provided below.

Environmental Manipulation

A. House Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the environmental manipulation, two studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2=0.07$ ($p=0.79$) with associated $I^2<0.01\%$ which shows that there is a strong consistency in the results of the study in terms of its house index. Furthermore, it is seen that the odds of a House index being better in the experimental group has an OR=0.59 (95% CI=0.37-0.92) suggesting that the intervention used was effective in preventing dengue. The Odds Ratio also has an associated overall effect $Z=2.33$ ($p=0.02$) indicative that the effects are statistically significant at 5% level of significance.

C. Breteau Index

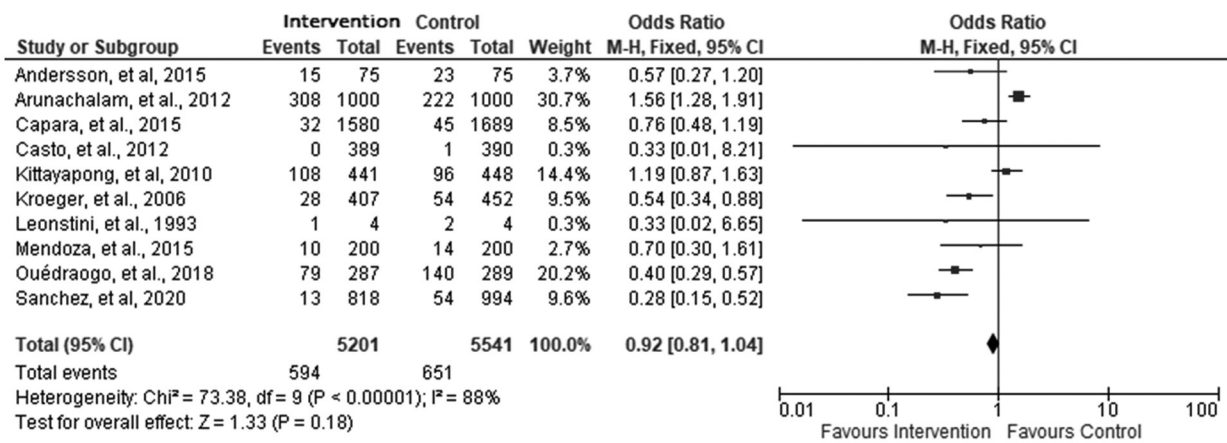


Figure 4. Forest plot of Breteau Index performance among included studies.

A. House Index

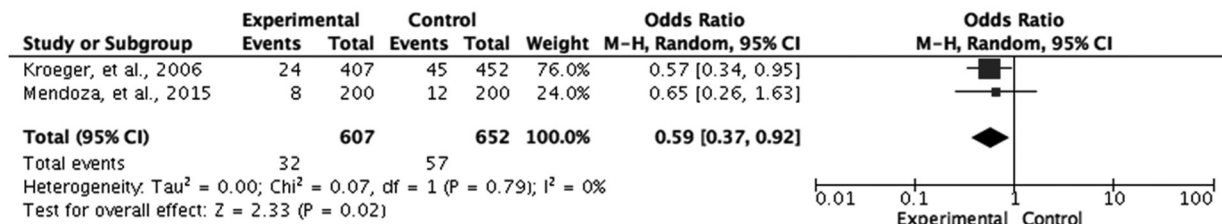


Figure 5. Forest plot of House Index performance among included studies that used environmental manipulation.

B. Container Index

This is a sub analysis of the different methodologies used in addressing dengue in the area. In terms of the environment manipulation, two studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 0.08$ ($p=0.78$) with associated $I^2 \leq 0.01\%$ which shows that there a strong consistency in the results of the study in terms of its container index. Furthermore, it is seen that the odds of a Container index being better in the experimental group has an OR=0.54 (95% CI=0.20-1.44) suggesting an equivocal effect. The Odds Ratio also has an associated overall effect $Z=1.23$ ($p=0.22$) indicative that the effects are not statistically significant at 5% level of significance.

C. Breteau Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the environment manipulation, two studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 0.26$ ($p=0.61$) with associated $I^2 < 0.01\%$ which shows that there a strong consistency in the results of the study in terms of its Breteau index. Furthermore, it is seen that the odds of a Breteau index being better in the experimental group has an OR=0.58 (95% CI=0.33-0.88) suggesting that the intervention used was effective in preventing dengue. The Odds Ratio also has an associated overall effect $Z=2.58$ ($p=0.010$) indicative that the effects are statistically significant at 5% level of significance.

Human Behavior

A. House Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the human behavior interventions, four studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 10.37$ ($p=0.03$) with associated $I^2 = 71\%$ which shows that there is still a substantial heterogeneity in the results of the study. Furthermore, it is seen that the odds of a House index being better in the experimental group has an OR=0.82 (95% CI=0.55-1.22) suggesting an equivocal effect. The Odds Ratio also has an associated overall effect $Z=1.00$ ($p=0.32$) indicative that the effects are not statistically significant at 5% level of significance.

B. Container Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the human behavior interventions, four studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 2.30$ ($p=0.32$) with associated $I^2 = 13\%$ which shows that there is consistency in the results of the study. Furthermore, it is seen that the odds of a Container index being better in the experimental group has an OR=0.36 (95% CI=0.24-0.54) suggesting that the intervention used was effective in preventing dengue. The Odds Ratio also has an associated overall effect $Z=5.01$ ($p < 0.01$) indicative that the effects are statistically significant at 5% level of significance.

B. Container Index

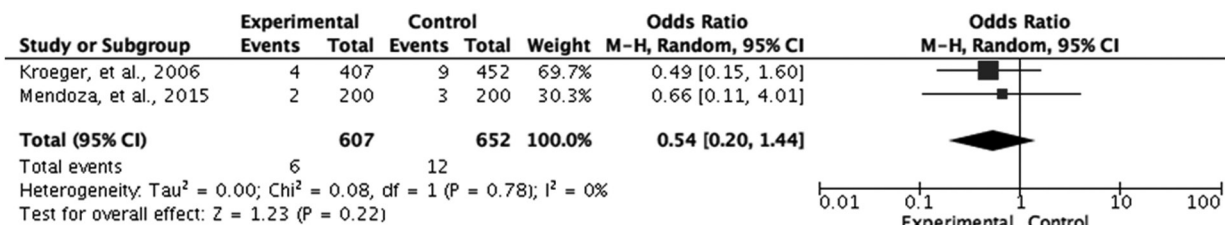


Figure 6. Forest plot of Container Index performance among included studies that used environmental manipulation.

C. Breteau Index

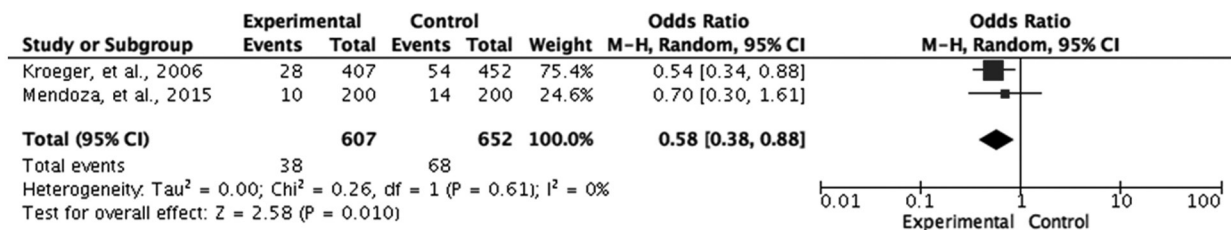


Figure 7. Forest plot of Breteau Index performance among included studies that used environmental manipulation.

C. Breteau Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the human behavior interventions, four studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 20.91$ ($p < 0.01$) with associated $I^2 = 90\%$ which shows that there is heterogeneity among the results of the studies. Furthermore, it is seen that the odds of a Breteau index being better in experimental group has an OR=0.66 (95% CI=0.30-1.44) suggesting an equivocal effect. The Odds Ratio also has an associated overall effect $Z=1.05$ ($p=0.29$) indicative that the effects are not statistically significant at 5% level of significance.

Environmental Modification and Human Behavior

A. House Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the Environment Modification and Human Behavior, three studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 17.22$ ($p < 0.01$) with associated $I^2 = 88\%$ which shows that there is presence of heterogeneity in terms of its house index. Furthermore, it is seen that the odds of a House index being better in the experimental group has an OR=0.46 (95% CI=0.14-1.48) suggesting that the effects are equivocal. The Odds Ratio also has an associated overall effect $Z=1.30$ ($p=0.190$) indicative that the effects are not statistically significant at 5% level of significance.

A. House Index

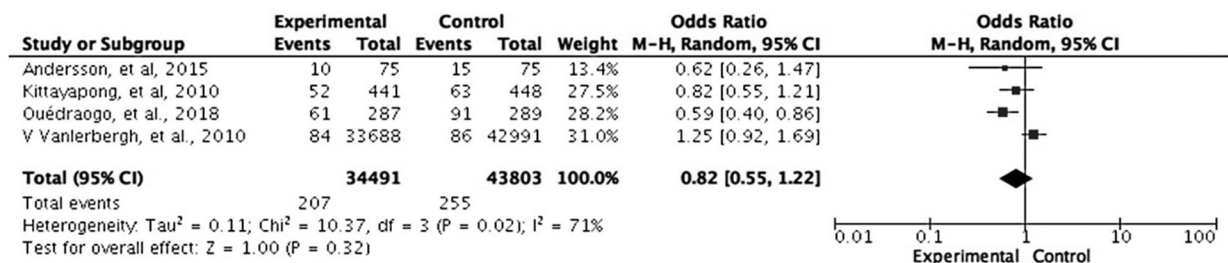


Figure 8. Forest plot of House Index performance among included studies that used human behavior.

B. Container Index

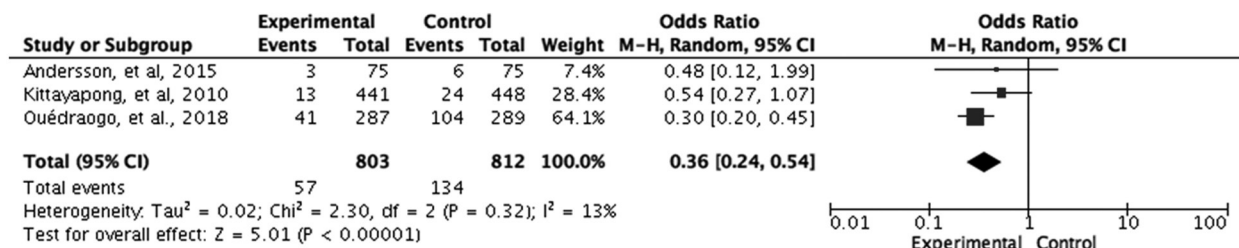


Figure 9. Forest plot of Container Index performance among included studies that used human behavior.

C. Breteau Index

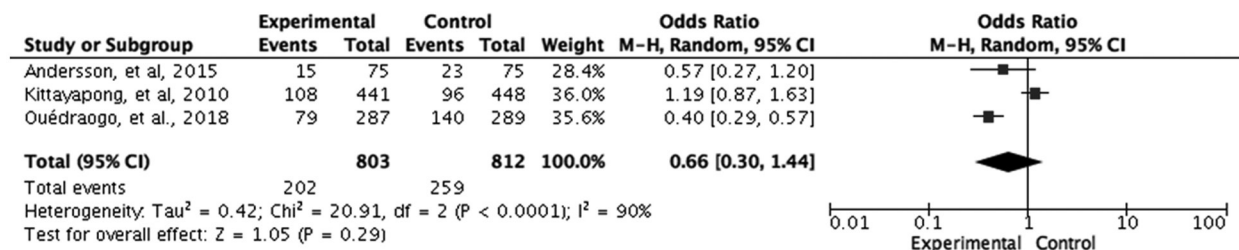


Figure 10. Forest plot of Breteau Index performance among included studies that used human behavior.

B. Container Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the Environment Modification and Human Behavior, three studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 3.38$ ($p=0.180$) with associated $I^2=41\%$ which shows that there is presence of heterogeneity in terms of its container index. Furthermore, it is seen that the odds of a Container index being better in the experimental group has an $OR=0.97$ (95% $CI=0.64-1.48$) suggesting that the effects are equivocal. The Odds Ratio also has an associated overall effect $Z=0.12$ ($p=0.90$) indicative that the effects are not statistically significant at 5% level of significance.

C. Breteau Index

This is a sub analysis of the different methodologies in addressing dengue in the area. In terms of the Environment Modification and

Human Behavior, three studies were included. In the analysis of the studies' consistency of results, a homogeneity test using Cochran Q test revealed that $\chi^2 = 6.93$ ($p=0.03$) with associated $I^2=71\%$ which shows that there is presence of heterogeneity in terms of its Breteau index. Furthermore, it is seen that the odds of a Container index being better in the experimental group has an $OR=1.13$ (95% $CI=0.63-2.03$) suggesting that the intervention used did not show effectiveness in preventing dengue. However, the Odds Ratio has an associated overall effect $Z=0.41$ ($p=0.68$) indicative that the effects are not statistically significant at 5% level of significance.

DISCUSSION

In the conduct of this systematic review and meta-analysis, it has been found that the community-based programs used in the included studies were generally effective in preventing dengue using House index, Container index and Breteau index as the outcome of measure. The subgroup analysis conducted on the different interventions used

A. House Index

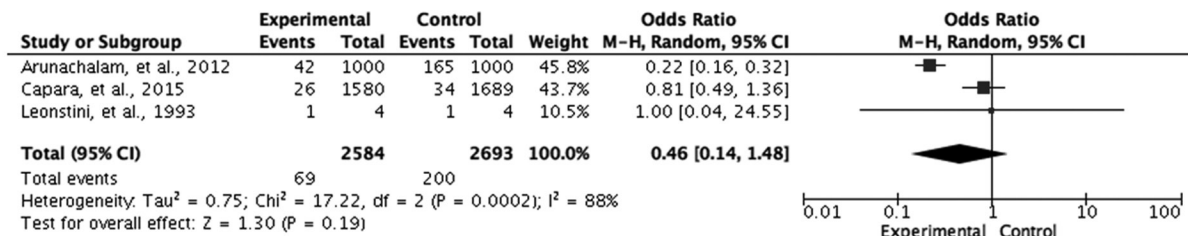


Figure 11. Forest plot of House Index performance among included studies that used environmental modification and human behavior.

B. Container Index

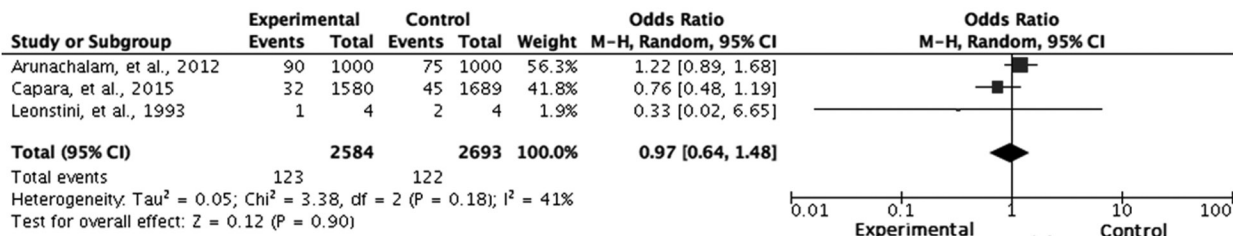


Figure 12. Forest plot of Container Index performance among included studies that used environmental modification and human behavior.

C. Breteau Index

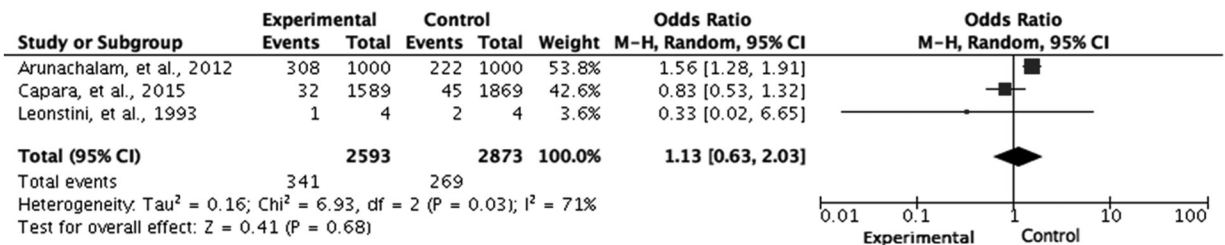


Figure 13. Forest plot of Index performance among included studies that used environmental modification and human behavior.

showed that environmental manipulation had a greater effect towards dengue prevention as compared to human behavior alone or in combination with it. In this subgroup analysis involving environmental manipulation, two studies were included which were by Kroeger, et al. and Mendoza et.al.^{18,20} The former used curtains and water container covers treated with insecticide and the latter used long-lasting insecticidal house net screens (LLIS) in combination with targeted treatment of the most productive *Aedes aegypti* breeding sites. The odds ratio of the dengue indices involved in the abovementioned studies were less than 1 (House index OR=0.59, Container Index OR=0.54; Breteau Index OR=0.58) which means the environmental manipulation interventions used in these studies were effective in preventing dengue. The results of the studies were also found to be statistically significant with a p-value of <0.05 except for the Container Index which was not statistically significant with a p-value of 0.22. On the other hand, in the subgroup analysis involving human behavior, the results were equivocal except for the Container Index. While in the subgroup analysis involving both human behavior and environmental modification, the results were also equivocal aside from the Container Index which favored the control group and showed that the intervention used was ineffective. However, the over-all results showed that it was not statistically significant.

Environmental management, in general, would need community participation for the program to be properly implemented. Participation of community leaders and residents is vital to the success of dengue prevention as they will be the prime movers of these programs/interventions. An earlier systematic review included multiple types of interventions (chemical, biological, and community-based), concluding that integrated interventions including community involvement were the most effective.³⁰ The different types of environmental management included in this systematic review and meta-analysis showed varied effects as to the prevention of dengue. It is in the environmental manipulation that showed more promising results as previously discussed. According to an article from a peer-reviewed book on environmental management, environmental modification and /or human behavior resulted to a decrease in trend in the epidemiology of the diseases transmitted by some vectors. However, there are still some diseases vectored by mosquitoes that continue to destroy mankind because of changes in the vector's biology over time or ineffectiveness of these interventions to fit into the current trends of Integrated Mosquito Management protocol. Environmental manipulation was seen to provide a more workable solution to mosquito vector control as its ultimate goal is to make adult mosquitoes less fit to become vectors through changing the quality of established mosquito breeding sites.³¹

One of the limitations in this study was missing data in previous studies which could have been included in the review. The review authors tried to contact the original authors of these studies for clarification but unfortunately no response was given. The excluded studies could have helped strengthen the results of this systematic review and meta-analysis.

Grading the Quality of Evidence

The quality of evidence for this systematic review were assessed using the "Grades of Recommendations Assessment, Development and Evaluation (GRADE)" approach. The certainty of the evidence as to

whether it is high, moderate, low, and very low were assessed based on the five GRADE considerations namely: risk of bias, consistency of effect, imprecision, indirectness, and publication bias. A summary of findings table and evidence profile were created after assessment of the quality of evidence per outcome. Studies with a p-value of <0.05 were considered statistically significant.

CONCLUSION

Environmental management as a strategy to prevent dengue is effective when it involves the participation of the community. From the 3 different types of environmental management which are environmental manipulation, environmental modification and human behavior, it is those studies that made use of environmental manipulation with community involvement that had greater effects when it comes to dengue prevention. This could be due to the fact that environmental manipulation directly targets the quality of the established vector breeding sites which would mean less chances of reproduction and eventually control the number of vectors. The participation of the community is important in carrying out this strategy so as to detect and target more vector breeding sites and also to ensure a more sustainable strategy in controlling and preventing dengue.

RECOMMENDATION

The review authors recommend to use community-based programs as a strategy to help prevent dengue. Capacity-building through community empowerment should be promoted in communities where dengue is seen as a health threat. Members of the community should be educated and equipped with knowledge and practices that contribute to dengue control. As environmental management can only be as effective if people in the community are willing to participate in it and have the desire to continue and maintain good community practices.

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