BORNEO EPIDEMIOLOGY JOURNAL | BEJ

REVIEW ARTICLE Open Access

CHALLENGES OF DENGUE CONTROL AND PREVENTION WORLDWIDE: A SYSTEMATIC REVIEW

Norsyahida Md Taib[1,2*], Wan Hafizu Nazrin Wan Mohamad Lotfi[1,2], Azulaikha Alias[1,2], Muhammad Aklil Abd Rahim[1], Abdul Rahman Ramdzan[1], Syed Sharizman Syed Abdul Rahim[1]

Abstract

Dengue fever is a mosquito-borne disease representing significant public health challenges worldwide. Management of dengue prevention and control faces numerous challenges, including rapid urbanization, climate change, and socioeconomic inequalities. This systematic review aims to determine the challenges of the dengue control and prevention strategies. This review conducted a comprehensive search of articles published from 2013 to 2024, utilizing databases such as Scopus, ScienceDirect, and PubMed. The Preferred Reporting Items for Systematic Reviews (PRISMA) are used to improve transparency and completeness of reporting, and the Joanna Briggs Institute (JBI) is used for critical appraisal. The findings from the risk of bias assessment revealed moderate to high quality across the studies, with scores ranging from 5 to 9 out of 10. The populations studied included community members, health officers, healthcare workers, caregivers, and health surveillance experts representing diverse geographic locations like Malaysia, Thailand, the Dominican Republic, and Brazil. The types of studies included were qualitative, with one case report. Major challenges identified include weak community participation, inconsistent stakeholder coordination, socioeconomic constraints, and environmental factors affecting vector control sustainability. Integrated strategies combining traditional and innovative approaches, with strong community involvement and inter-sectoral collaboration, are essential for sustainable dengue control. In conclusion, the management of dengue needs integrated strategies that combine traditional methods with innovative approaches. In addition, it is crucial to involve the community and coordinate with stakeholders to enhance the effectiveness of dengue control measures by adapting to the local context. Future research should focus on developing sustainable and community-driven interventions, as well as enhancing inter-sectoral collaboration to address the multifaceted challenges of dengue prevention and control.

Keywords: Dengue fever, Challenges, Dengue control, Dengue prevention

*Correspondence Email: kpnsejati112@gmail.com

[1]*Department of Public Health Medicine, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Sabah, Malaysia*

[2]*Sabah State Health Department, Ministry of Health Sabah, Tingkat 1,3 & 6, Rumah Persekutuan, Jalan Mat Salleh, 88590 Kota Kinabalu, Sabah, Malaysia*

Received: 03/08/2025
Accepted: 30/10/2025
Published: 04/11/2025

INTRODUCTION

Dengue fever, a viral disease transmitted by mosquitoes, has become a significant public health concern in tropical and subtropical regions globally. It is a viral infection that causes acute fever, severe headache, and muscle and joint pains (WHO, 2023). Approximately 400 million individuals each year, resulting in considerable morbidity and economic burden (Ho et al., 2023). Dengue fever is caused by the dengue virus (DENV), consisting of four serotypes, which are dengue virus 1 through dengue virus 4, making its spread complex and challenging to control (Bäck & Lundkvist, 2013).

The global prevalence of dengue has significantly risen due to urbanization, increased international travel, inadequate mosquito control, and climate change. These factors have led to the expansion of breeding seasons and geographic range of Aedes mosquitoes, particularly Aedes aegypti and Aedes albopictus (Abdullah et al., 2022). The adaptability of these vectors to urban environments poses additional challenges for control efforts (Gubler, 2011). Seasonal epidemics frequently occur, with the monsoon rains creating favorable breeding conditions for mosquitoes, thereby exacerbating the situation (Gui et al., 2022).

The burden of disease in the Western Pacific Region accounts for 75% of the global burden. The incidence of dengue cases in this region increased steadily from 0.20 million in 2011 to over 0.45 million in 2015 and further to 0.68 million in 2019. The Western Pacific Region experienced a 50% decrease in dengue deaths from 0.32% in 2008 to 0.16% in 2014, attributed to improved case management (Saeed & Asif, 2020). The decrease in reported dengue cases in 2020 can be attributed to reduced surveillance efforts during the COVID-19 pandemic due to a lack of resources and a decrease in the accessibility of healthcare services (Md Iderus et al., 2023). In Malaysia, dengue outbreaks have been recorded since 1902, with 123,133 cases reported in 2023 an 86.3% increase from 2022 (iDengue, 2024). In epidemiological week 6 of 2024, there were 22,058 reported dengue cases, representing a 68.5% rise from the 13,094 cases reported during the same period in 2023. There were 10 dengue-related deaths reported by week 6 of 2024, an increase from 9 deaths during the same period in 2023 (WHO Western Pacific Region, 2024).

Vector control strategies for dengue prevention and control consist of source reduction, larvaciding, space spraying, targeted outdoor residual spraying, health promotion, and law enforcement. The current control and prevention measures in Malaysia effectively reduce the morbidity and mortality of dengue cases (Ismail et al., 2022). The goal of vector control is to decrease the density of vectors to a level that prevents transmission, targeting both the larval and adult stages of the Aedes mosquito (Talbot et al., 2021).

New innovative approaches in dengue control include the release of Wolbachia-infected mosquitoes (Vektor et al., 2016). The Sterile Insect Technique (SIT) is a biological method that involves utilizing ionizing radiation, specifically gamma rays emitted by cobalt-60 and cesium-137 radioisotopes, or X-rays, to sterilize male mosquitoes (Nazni et al., 2021). The Institute of Medical Research (IMR) Malaysia has introduced a new approach called targeted outdoor residual spray (ORS) by applying a low dose of pyrethroid to outer surfaces where mosquitoes are believed to hide or rest in dengue hotspot areas or regions with frequent dengue outbreaks (Saadatian-Elahi et al., 2021).

Vector control strategies, such as source reduction, larviciding, fogging, and health promotion, remain the core of dengue prevention efforts (Ismail et al., 2022). However, sustaining these efforts is challenged by community fatigue, inconsistent stakeholder collaboration, and environmental adaptability of mosquito vectors. Therefore, this review aims to identify and synthesize the main challenges in the management of dengue control and prevention worldwide using a systematic approach.

METHODS

Design

This study adopts systematic review as its research design, with the Preferred Reporting Items for Systematic Reviews (PRISMA) statement guidelines utilized to improve transparency and completeness of reporting in systematic reviews (M.J., McKenzie, J.E., Bossuyt, 2021). Then, guidelines for evaluating the quality of studies were using The Joanna Briggs Institute (JBI) critical appraisal for case reports (Moola et al., 2015) and qualitative study (Lockwood et al., 2015).

Data Sources and Search Strategies

The search strategy only aims to identify published articles. The databases searched include Scopus, ScienceDirect, and PubMed. This is followed by a search using all identified keywords in the titles and abstracts, along with the index terms used to describe each article. Studies are limited to those published in English from 2013 to 2024. Keywords in this study are adjusted to the Medical Subject Heading (MeSH) and use a combination of Boolean operators (AND and OR), namely “challenges” AND “dengue control” OR “dengue prevention.”

Three reviewers independently assess the titles and abstracts of all studies to determine their relevance according to predefined inclusion criteria. Studies that pass the initial screening proceed to full-text review. Each reviewer independently evaluates the full text to determine whether to include or exclude it based on the study's relevance and quality. In cases where there is disagreement between the two reviewers regarding the inclusion or exclusion of a study, a third reviewer is usually brought in to resolve the conflict. This process ensures comprehensive consideration of all potential studies and minimizes bias risk. The disagreements can be resolved through discussion or by a third reviewer making the final decision.

The articles included in this systematic review meet specific criteria. Firstly, the study should focus on challenges associated with dengue prevention and control. Secondly, the articles considered articles published from 2013 until 2024. The timeline was selected to include the most recent evidence published since the previous systematic review conducted over 6 years ago. This time frame allows for incorporating recent research that may offer further insights or updated results. Lastly, only articles published in the English language are included.

Quality Assessment

Studies will then be assessed for their quality before any information retrieval. Any disagreements that arise between the reviewers will be resolved through discussion. All selected articles will be judged for their quality based on The Joanna Briggs Institute (JBI) critical appraisal for case reports study (Moola et al., 2015) and qualitative study(Lockwood et al., 2015). The three reviewers conducted the quality assessment independently, resolving any discrepancies in quality rating through discussion.

This tool has a checklist of ten questions covering the reviewer or a team of reviewers who systematically review each question in the JBI tool pertinent to the study design. Responses generally involve a yes, no, unclear, or not applicable option, enabling the appraiser to determine the extent of bias in the study. Each criterion that received a 'yes' score was given one point, while other responses score zero. The scores for each study were then calculated and summed. An evaluation method is used to assess studies conducted by researchers. Each study was critically appraised using the JBI checklist. Articles achieving $\geqslant$50% of the total score were included. The qualitative studies scored between 8 and 9 out of 10, and the case report scored 5 out of 8, indicating moderate to high quality (Lockwood et al., 2015; Moola et al., 2015).

Data Extraction

Three reviewers will independently assess all studies. Data extracted included author, year, country, participants, objectives, database source, and major findings. Themes were identified through meta-aggregation, and results were synthesized narratively.

Synthesis of Result

Study themes found in each article results were tabulated. The themes and subthemes found in the studies were then discussed in the discussions section.

RESULTS

The literature review was performed following PRISMA guidelines to select eligible articles (M.J., McKenzie, J.E., Bossuyt, 2021). The search strategy resulted in 1461 citations, with 84 from Scopus, 302 from ScienceDirect, and 1075 from PubMed. These citations were obtained through electronic database searches and were limited to articles published in English. Out of these, 660 were duplicates. Furthermore, 23 relevant articles were identified, and the full texts were retrieved and analysed. 17 studies were excluded, and 6 studies met the review inclusion criteria as in (Figure 1).

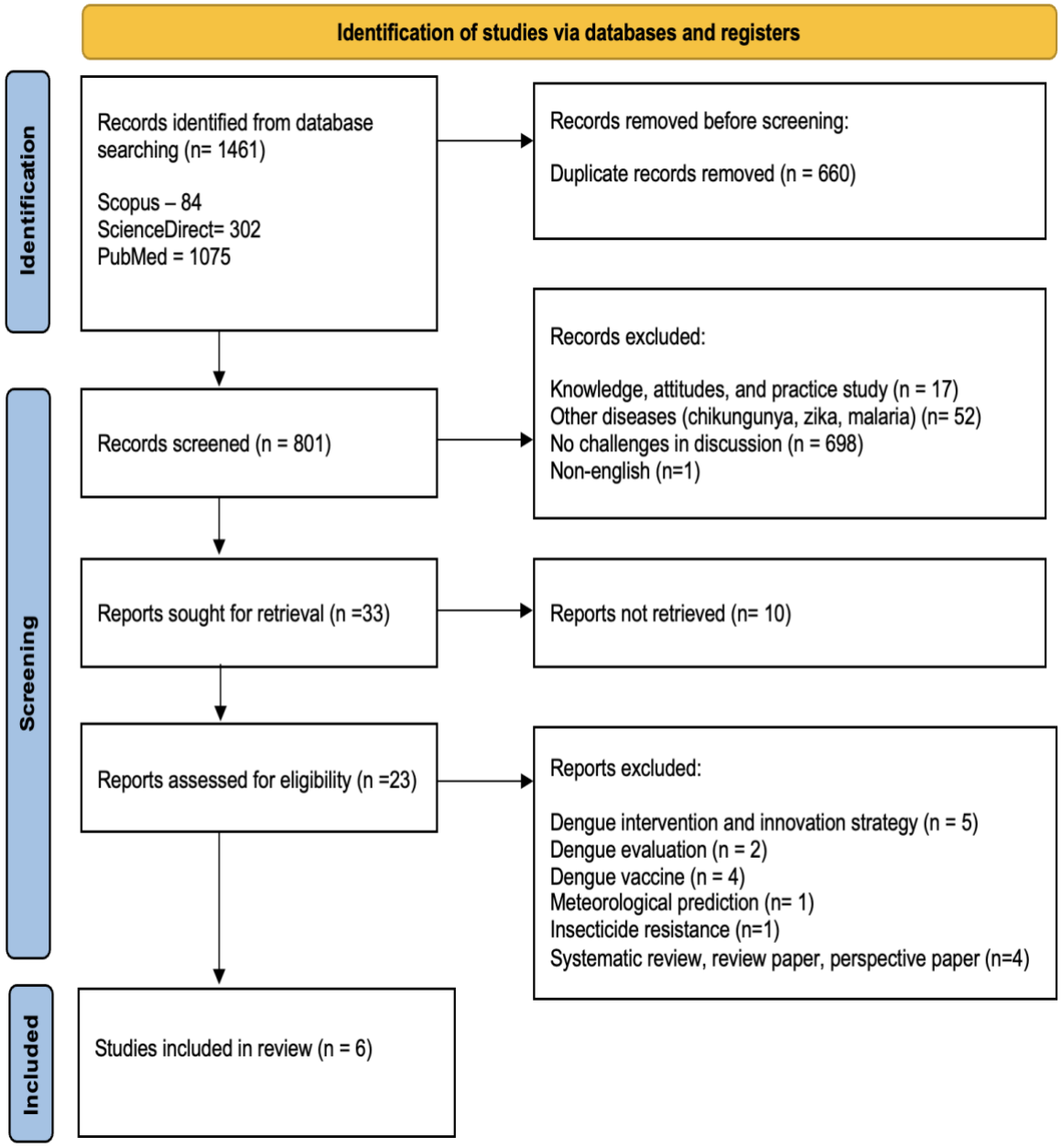

Figure 1: PRISMA 2020 flow diagram for new systematic reviews, which included searches of databases and registers only.

After searching three electronic databases, a total of 6 articles were identified that satisfied the inclusion criteria for this systematic review. More details regarding this systematic review, such as the author's name, year of publication, study design, number of participants, objectives, and a summary of the results, can be found in (Table 1).

Table 1: Summary of included literature

Author, Year, Country	Study Design	Participants	Database Source	Objective	Key Findings	Themes
Samsudin et al. (2024), Malaysia	Qualitative	42 participants	Scopus	Explore local community behaviors and stakeholder challenges	Limited community engagement and poor coordination between agencies	Community behavior, Stakeholder challenge
Srichan et al. (2018), Thailand	Qualitative	10 district health officers	ScienceDirect	Explore challenges of fogging operations	Resistance to fogging and low public cooperation	Community engagement, Public cooperation
Veras-Estévez & Chapman (2017), Dominican Republic	Qualitative	19 healthcare workers	PubMed	Identify perceived challenges among healthcare workers	Low socioeconomic support, poor awareness	Community engagement, Socioeconomic factor
Viennet et al. (2016), Singapore, Taiwan, US, Australia	Case report	–	PubMed	Review challenges and public health responses in high-income countries	Urbanization and imported cases pose ongoing risks	Environmental factor, Demographic factor
Frank et al. (2017), Peru	Qualitative	18 caregivers	Scopus	Explore caregiver experiences and perceptions	Misunderstanding of dengue symptoms and transmission	Community behavior, Stakeholder challenge
Angelo et al. (2020), Brazil	Qualitative	17 surveillance experts	ScienceDirect	Explore strengths and weaknesses of Brazilian surveillance	Incomplete reporting and lack of private sector data	Stakeholder challenge

Five qualitative research studies were conducted using the Joanna Briggs Institute (JBI) checklist, as shown in (Table 2). The assessment of each study is based on ten criteria, with a "+" indicating that the criterion is met and a "-" indicating that it is not (Angelo et al., 2020; Samsudin et al., 2024; Srichan et al., 2018) achieved a score of 8 out of 10. The omission of criteria 6 and 7 suggests potential deficiencies in areas such as locating the researcher culturally or theoretically and the researcher's influence or the clarity of conclusions. The two articles, (Frank et al., 2017; Veras-Estévez & Chapman, 2017) achieved a score of 9 out of 10, indicating that they fulfilled almost all criteria, with only locating the researcher's cultural or theoretical issue.

Table 2: JBI critical appraisal checklist for qualitative research

No	Author	1	2	3	4	5	6	7	8	9	10	Score
1	(Samsudin et al., 2024)	+	+	+	+	+	-	-	+	+	+	8
2	(Srichan et al., 2018)	+	+	+	+	+	-	-	+	+	+	8
3	(Veras-Estévez & Chapman, 2017)	+	+	+	+	+	-	+	+	+	+	9
4	(Frank et al., 2017)	+	+	+	+	+	-	+	+	+	+	9
5	(Angelo et al., 2020)	+	+	+	+	+	-	-	+	+	+	8

The JBI checklist for case reports was used to evaluate a single case report (Viennet et al., 2016) across eight criteria as in Table 3. This article achieved a score of 5 out of 8, suggesting that it fulfilled most of the criteria but had notable deficiencies in three aspects, possibly due to unclear diagnostic tests or assessment methods, unclear post-intervention clinical condition and insufficient to identify or describe adverse events (harms) or unanticipated events.

Table 3: JBI critical appraisal checklist for case report

No	Author	1	2	3	4	5	6	7	8	Score
1	(Viennet et al., 2016)	+	+	+	-	+	-	-	+	5

Summary of Main Themes

Although Viennet et al. (2016) is a case report, it was included because it provides valuable contextual evidence from high-income countries where dengue control strategies differ, enriching the comparative understanding of global dengue challenges. Across the six studies, four dominant themes emerged:
(1) weak community participation and behavioral barriers
(2) limited stakeholder coordination and resource constraints
(3) socioeconomic inequalities affecting prevention uptake
(4) environmental and climatic factors sustaining vector habitats.
These interlinked challenges emphasize the need for integrated and community-driven dengue control strategies.

DISCUSSION

The Challenges of Dengue Control and Prevention

Community behaviour

The battle against dengue fever continues to be a pressing global public health issue. Controlling this disease relies heavily on community awareness and proactive measures. Residents in different regions vary in their awareness and engagement in dengue prevention activities. Districts with lower incidence rates tend to have robust community networks crucial for effective dengue control (Angelo et al., 2020; Samsudin et al., 2024; Srichan et al., 2018). Nevertheless, despite the extensive efforts in health education, a significant number of community members still struggle to effectively implement preventive strategies (Veras-Estévez & Chapman, 2017).

Community participation plays a crucial role in determining the effectiveness of dengue management. One common challenge is the lack of community involvement, which is made worse by public weariness and doubt about current prevention efforts (Viennet et al., 2016). Many believe the lack of cooperation stems from a mindset where community members rely on the government or health centres to take charge (Frank et al., 2017).

There were significant challenges to overcome, as many residents were hesitant and uncooperative. They were reluctant to allow spraying inside their homes due to concerns about chemical exposure and disruptions (Srichan et al., 2018). To effectively control dengue, the entire community must come together and act, as the choices made by one household can have far-reaching consequences for the entire neighbourhood. Nevertheless, communities frequently suffer from a lack of collaborative spirit and collective action, which undermines their community-wide prevention efforts (Veras-Estévez & Chapman, 2017).

Stakeholder challenge

Regarding resources, the sustainable prevention and control of dengue can be challenging due to limited financial and material resources. This limitation significantly impacts the effectiveness and efficiency of education campaigns and other preventive initiatives (20–22). In addition, the inconsistent public health responses and infrastructure resulting from budget cuts present additional obstacles in sustaining efficient vector control and surveillance programs (Viennet et al., 2016).

Efforts to coordinate and enforce dengue prevention measures among various authorities have consistently encountered challenges, affecting the overall effectiveness of response efforts. Efficient collaboration between agencies is essential for a cohesive approach to dengue control, but the process is often hindered by jurisdictional constraints. The lack of coordination can result in fragmented efforts and inefficiencies in implementing prevention strategies, ultimately impeding the speed and effectiveness of responding to dengue outbreaks (Samsudin et al., 2024).

Education and public awareness play a crucial role in addressing the issue of dengue. Unfortunately, valuable educational materials are occasionally subjected to vandalism and theft, which hampers the efforts to disseminate knowledge (Samsudin et al., 2024). Caretakers'

understanding of dengue fever emphasizes an adequate understanding of its symptoms and modes of transmission. However, there are still noteworthy misunderstandings, especially regarding the biting habits of mosquitoes. The confusion between the behaviours of mosquitoes that transmit dengue (primarily Aedes aegypti and Aedes albopictus) and those that spread other diseases like malaria (typically carried by Anopheles mosquitoes) can complicate prevention efforts. This can lead to misunderstandings among parents (Frank et al., 2017).

Several factors contribute to the challenges in addressing dengue outbreaks. These factors include delays in reporting cases, lack of effective communication between hospitals and public health offices, and logistical issues in designated areas for spraying (Samsudin et al., 2024). The study highlighted significant challenges, including the insufficient reporting of cases, particularly from the private sector, and a shortage of human and technological resources that impede the notification process and data analysis. One problem that arises in data collection and reporting is the failure to integrate private healthcare data, which leads to inefficiencies in data collection and processing (Angelo et al., 2020).

Sociodemographic factor

Low socioeconomic status presents significant challenges for many community members in affording and sustaining effective dengue prevention measures such as mosquito nets or repellents. Due to economic constraints, individuals often prioritize basic needs over preventive health measures, potentially increasing their susceptibility to dengue (Veras-Estévez & Chapman, 2017). There is a need for targeted protection measures for children and rural community members, who are perceived as highly susceptible to dengue. Focused efforts to protect these vulnerable groups are crucial for reducing the impact of the disease within these populations (Frank et al., 2017).

On the other hand, high-income countries conveniently located near or connected to dengue-endemic areas face the ongoing challenge of imported cases through travellers. This constant virus introduction adds complexity to managing local transmission. Additionally, as population densities soar and urbanization occurs rapidly, more man-made breeding sites for mosquitoes can be created due to inadequate infrastructure. This is particularly concerning in locations such as Singapore and parts of Florida, where urban sprawl and favourable mosquito breeding conditions converge (Viennet et al., 2016).

Environmental factor

The presence of competent mosquito vectors, specifically Aedes aegypti and Aedes albopictus, is crucial. Controlling the spread of the virus is challenging due to its abundance and ability to thrive in urban and suburban areas. This adaptability poses significant challenges in controlling the spread of the virus, as these mosquitoes find suitable breeding grounds in a wide range of settings, making eradication efforts complex and demanding sustained coordinated public health strategies (Viennet et al., 2016).

The impact of weather patterns on mosquito populations and virus transmission is substantial. Fluctuations in rainfall, temperature, and humidity can significantly influence mosquito breeding sites and their population dynamics. Adapting mosquito control measures to these ever-changing environmental conditions remains a significant challenge. This variability requires flexible and responsive control strategies that can adjust to rapid changes in weather

patterns to effectively manage mosquito populations and curb the spread of viruses they carry (Viennet et al., 2016).

The Recommendations for Dengue Control and Prevention

The control and prevention of dengue require a comprehensive approach involving multi-agency and multi-strategies, such as vector control, community engagement, healthcare strengthening, and research advancements. Integrated vector management to reduce mosquito key breeding sites by combining multiple control efforts. It includes environmental management in managing solid waste and ensuring proper water storage practices. Then, chemical control is done using larvicides and adulticides such as temephos, malathion, aqua resigen, and Bacillus thuringiensis israelensis (Bti). Employ biological control, like larvivorous fish and coepepods, to control mosquito larvae. The upscale biological intervention combines conventional and innovative methods, such as Wolbachia-infected mosquitoes and the Sterile Insect Technique (SIT), to reduce mosquito populations for the recurrence outbreak locality or dengue hotspot area.

Strengthen dengue surveillance systems with mandatory reporting and real-time data sharing. Integrating private healthcare data into public health surveillance to notify dengue cases within 24 hours can enhance outbreak detection and response accuracy and efficiency. Dengue control can be implemented in a timely manner to help mitigate the transmission. In addition, utilising the Geographical Information System (GIS) to map and visualize dengue cases can help identify hotspots and monitor disease spread. GIS can aid in spatial analysis and risk prediction by machine learning for accurate forecasting.

Enhance community participation by raising awareness about dengue prevention through educational initiatives and promoting proactive community behaviours. The way to increase the effectiveness of dengue control is by giving accurate information and education about the safety of fogging. Thus, it can help to prevent misconceptions about mosquito control measures and to foster greater cooperation. The acceptance of the community fogging inside their house can reduce the mosquito density, especially in outbreak areas. Incorporating community-based participatory research (CBPR) methods can help tailor educational initiatives to the specific needs and behaviours of the community. This approach ensures that the materials are relevant and culturally appropriate. It also needs to encourage the use of protective clothing, repellents, and insecticide-treated materials during the Aedes biting time via health promotion activity on television, radio, and social media.

Next, collaborate with the school health unit to develop and implement school-based dengue intervention programs that use participatory and customized training materials to promote sustainable behavioural change among students. Developing customized training materials for school-based interventions can significantly improve knowledge and practice regarding dengue prevention. Techniques include using PowerPoint presentations, animated videos, colouring activities, games, and dengue zero field trips to learn how to identify the Aedes key breeding site. Moreover, interactive tools such as board games can make learning about dengue prevention fun and engaging. For example, the "Goodbye-to-Dengue Game" and “Aedes Larvae Ladder” can help to increase knowledge and self-efficacy among school children and adolescents.

Utilising digital platforms and social media for health education can enhance outreach to a wider audience and improve information accessibility. Utilising apps, interactive websites,

and social media campaigns can effectively distribute dengue prevention information. Health education materials should be visually appealing and easy to understand. Using colourful graphics, infographics, and engaging narratives can capture attention and improve the retention of information. The community leader plays a vital role in educating residents about dengue's dangers, its transmission, and preventive measures. This involves organizing awareness campaigns and informational sessions to disseminate accurate information. By building trust within the community, leaders can encourage greater participation in dengue prevention activities. Their influence can lead to higher compliance with recommended practices and more effective community engagement.

Strength

The strength of this study was that it utilized extensive database searches, including Scopus, ScienceDirect, and PubMed, adhering to PRISMA guidelines for systematic reviews and enhancing the review's transparency and completeness. The inclusion of a critical appraisal using the Joanna Briggs Institute (JBI) guidelines ensured a rigorous evaluation of the quality of the included studies, thereby strengthening the reliability of the review findings.

This review was guided by a well-defined research question aimed at identifying challenges in managing dengue control and prevention, which helps address specific issues effectively. Moreover, the review offers a broader perspective on the challenges faced across different demographic and geographic scopes by selecting studies that involve different populations and settings (community workers, public health providers, and volunteers in endemic areas). The novel value of this systematic review lies in its comprehensive and updated synthesis of evidence from 2013 to 2024, addressing gaps in previous research.

Besides that, the focus on qualitative studies allows for a deeper understanding of the community, socioeconomic, and systemic challenges in dengue prevention, providing rich, context-specific insights. Multiple reviewers performed the data extraction and quality assessment independently, reducing the risk of bias in the review process.

Limitation

This review only evaluated articles published in English from 2013 to 2024 and did not consider studies in other languages. Book chapters and grey literature are not included, which could offer valuable insights into dengue prevention and control strategies. The systematic review follows PRISMA guidelines and utilizes JBI critical appraisal tools. However, it is important to consider the potential impact of biases and methodological limitations in the included studies on the outcomes. Some studies did not receive high appraisal scores, suggesting that there may be differences in study quality that could impact the strength of the conclusions made.

CONCLUSION

This systematic review focuses on the challenge of various factors that impact dengue control and prevention efforts. Effective management of dengue requires a coordinated approach that integrates traditional strategies with innovative solutions. The findings highlight the importance of global collaboration in improving vector control, public health education, and disease surveillance to effectively address the increasing dengue issue.

Acknowledgements

Thank all those who have helped in the process of making this manuscript.

Declaration of Confliction Interest

This comprehensive summary or systematic review is written independently, so there is no conflict of interest in the writing.

Funding

This systematic review is written independently and is not financed or receiving funding from any party.

REFERENCES

Abdullah, N. A. M. H., Dom, N. C., Salleh, S. A., Salim, H., & Precha, N. (2022). The association between dengue case and climate: A systematic review and meta-analysis. *One Health*, *15*, 100452. https://doi.org/10.1016/J.ONEHLT.2022.100452

Angelo, M., Ramalho, W. M., Gurgel, H., Belle, N., & Pilot, E. (2020). Dengue Surveillance System in Brazil: A Qualitative Study in the Federal District. *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 2062*, *17*(6), 2062. https://doi.org/10.3390/IJERPH17062062

Bäck, A. T., & Lundkvist, Å. (2013). Dengue viruses – an overview. *Infection Ecology & Epidemiology*, *3*(1), 19839. https://doi.org/10.3402/IEE.V3I0.19839

Frank, A. L., Beales, E. R., de Wildt, G., Meza Sanchez, G., & Jones, L. L. (2017). "We need people to collaborate together against this disease": A qualitative exploration of perceptions of dengue fever control in caregivers' of children under 5 years, in the Peruvian Amazon. *PLoS Neglected Tropical Diseases*, *11*(9). https://doi.org/10.1371/JOURNAL.PNTD.0005755

Gubler, D. J. (2011). Dengue, Urbanization and Globalization: The Unholy Trinity of the 21st Century. *Tropical Medicine and Health*, *39*(4SUPPLEMENT), S3–S11. https://doi.org/10.2149/TMH.2011-S05

Gui, H., Gwee, S., Koh, J., & Pang, J. (2022). Weather factors associated with reduced risk of dengue transmission in an urbanized tropical city. *International Journal of Environmental Research and Public Health*, *19*(1). https://doi.org/10.3390/ijerph19010339

Ho, S. H., Lim, J. T., Ong, J., Hapuarachchi, H. C., Sim, S., & Ng, L. C. (2023). Singapore's 5 decades of dengue prevention and control—Implications for global dengue control. *PLOS Neglected Tropical Diseases*, *17*(6), e0011400. https://doi.org/10.1371/JOURNAL.PNTD.0011400

iDengue. (2024). *iDengue_Versi 3.0*. https://idengue.mysa.gov.my/

Ismail, S., Fildes, R., Ahmad, R., Najdah, W., Ali, W. M., & Omar, T. (2022). *The practicality of Malaysia dengue outbreak forecasting model as an early warning system-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)*. https://doi.org/10.1016/j.idm.2022.07.008

Lockwood, C., Munn, Z., & Porritt, K. (2015). Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *International Journal of Evidence-Based Healthcare*, *13*(3), 179–187. https://doi.org/10.1097/XEB.0000000000000062

Md Iderus, N. H., Singh, S. S. L., Ghazali, S. M., Zulkifli, A. A., Ghazali, N. A. M., Lim, M. C., Ahmad, L. C. R. Q., Md Nadzri, M. N., Tan, C. V., Md Zamri, A. S. S., Lai, C. H., Nordin, N. S., Kamarudin, M. K., Wan, M. K., Mokhtar, N., Jelip, J., Gill, B. S., & Ahmad, N. A. R. (2023). The effects of the COVID-19 pandemic on dengue cases in Malaysia. *Frontiers in Public Health*, *11*, 1213514. https://doi.org/10.3389/FPUBH.2023.1213514/FULL

M.J., McKenzie, J.E., Bossuyt, P. M. et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMC Public Health*. https://doi.org/https://doi.org/10.1186/s13643-021-01626-4

Moola, S., Munn, Z., Sears, K., Sfetcu, R., Currie, M., Lisy, K., Tufanaru, C., Qureshi, R., Mattis, P., & Mu, P. (2015). Conducting systematic reviews of association (etiology): The Joanna Briggs Institute's approach. *International Journal of Evidence-Based Healthcare*, *13*(3), 163–169. https://doi.org/10.1097/XEB.0000000000000064

Nazni, W. A., Teoh, G.-N., Shaikh Norman Hakimi, S. I., Muhammad Arif, M. A., Tanusshni, M., Nuradila, M. A., Nurfarahin Hanini, A., Shazia, I. A., Tan, A.-M., Rabizah, H., Ahmad Zainuri, M. D., Hasnor Hadi, A., Cheong, Y.-L., Norazah, A., Maiga, H., Lees, R. S., & Han-Lim, L. (2021). Aedes Control Using Sterile Insect Technique (SIT) in Malaysia BT - Genetically Modified and other Innovative Vector Control Technologies: Eco-bio-social Considerations for Safe Application. *Genetically Modified and Other Innovative Vector Control Technologies*, 143–162. https://doi.org/10.1007/978-981-16-2964-8_8

Saadatian-Elahi, M., Alexander, N., Möhlmann, T., Langlois-Jacques, C., Suer, R., Ahmad, N. W., Mudin, R. N., Ariffin, F. D., Baur, F., Schmitt, F., Richardson, J. H., Rabilloud, M., & Hamid, N. A. (2021). Measuring the effectiveness of integrated vector management with targeted outdoor residual spraying and autodissemination devices on the incidence of dengue in urban Malaysia in the iDEM trial (intervention for Dengue Epidemiology in Malaysia): study protocol for a cluster randomized controlled trial. *Trials*, *22*(1), 1–16. https://doi.org/10.1186/S13063-021-05298-2/FIGURES/2

Saeed, O., & Asif, A. (2020). Dengue virus disease; the origins. *Dengue Virus Disease: From Origin to Outbreak*, 9–16. https://doi.org/10.1016/B978-0-12-818270-3.00002-3

Samsudin, N. A., Karim, N., Othman, H., Naserrudin, N. A., Sahani, M., Hod, R., Siau, C. S., Harif, M. N., Abd Samad, B. H., & Zaini, Z. I. I. (2024). Exploring community behaviours and stakeholder challenges in engaging communities with dengue prevention behaviour in Malaysia: implementation research for a qualitative study with a community-based participatory research design. *BMJ Open*, *14*(3), e074222. https://doi.org/10.1136/BMJOPEN-2023-074222

Srichan, P., Niyom, S. L., Pacheun, O., Iamsirithawon, S., Chatchen, S., Jones, C., White, L. J., & Pan-Ngum, W. (2018). Addressing challenges faced by insecticide spraying for the control of dengue fever in Bangkok, Thailand: a qualitative approach. *International Health*, *10*(5), 349–355. https://doi.org/10.1093/INTHEALTH/IHY038

Talbot, B., Sander, B., Cevallos, V., González, C., Benítez, D., Carissimo, C., Carrasquilla Ferro, M. C., Gauto, N., Litwiñiuk, S., López, K., Ortiz, M. I., Ponce, P., Villota, S. D., Zelaya, F., Espinel, M., Wu, J., Miretti, M., & Kulkarni, M. A. (2021). Determinants of Aedes mosquito density as an indicator of arbovirus transmission risk in three sites affected by co-circulation of globally spreading arboviruses in Colombia, Ecuador and Argentina. *Parasites and Vectors*, *14*(1), 1–14. https://doi.org/10.1186/S13071-021-04984-Z/TABLES/6

Undurraga, E. A., Halasa, Y. A., & Shepard, D. S. (2013). Use of Expansion Factors to Estimate the Burden of Dengue in Southeast Asia: A Systematic Analysis. *PLOS Neglected Tropical Diseases*, *7*(2), e2056. https://doi.org/10.1371/JOURNAL.PNTD.0002056

Vektor, K., Di Malaysia, D., Kajian, S., Dan, S., Alternatif, S., & Ong,) Song-Quan. (2016). Dengue Vector Control in Malaysia: A Review for Current and Alternative Strategies. *Sains Malaysiana*, *45*(5), 777–785.

Veras-Estévez, B. A., & Chapman, H. J. (2017). Health workers' perceived challenges for dengue prevention and control in the Dominican Republic. *MEDICC Review*, *19*(4), 26–34. https://doi.org/10.37757/MR2017.V19.N4.7

Viennet, E., Ritchie, S. A., Williams, C. R., Faddy, H. M., & Harley, D. (2016). Public Health Responses to and Challenges for the Control of Dengue Transmission in High-Income Countries: Four Case Studies. *PLOS Neglected Tropical Diseases*, *10*(9), e0004943. https://doi.org/10.1371/JOURNAL.PNTD.0004943

WHO. (2023). *Dengue and severe dengue*. https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue

WHO Western Pacific Region. (2024). *Dengue Situation Update 691 (Western Pacific Region)*.