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Community Attitudes towards Dengue Prevention in Malaysia: A Scoping Review and Implications for SDG 11

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Abstract
Dengue fever remains a significant urban health challenge in Malaysia, exacerbated by rapid urban development, inadequate waste management, and climate change. This study explores community attitudes toward dengue prevention and identifies factors influencing participation in mosquito control efforts, aligning with Sustainable Development Goal 11 (SDG 11). The research examines individual perceptions, community engagement, and urban governance through the lens of the Health Belief Model, the Theory of Planned Behavior, and the Social Ecological Model. A scoping review of 45 studies (2015–2023) reveals that knowledge, socio-demographics, and economic constraints impact prevention efforts. While urban residents are aware of dengue risks, engagement gaps persist due to limited interventions. Practical strategies, such as the Sterile Insect Technique (SIT) and Integrated Vector Management (IVM), show promise but require improved implementation. Strengthening digital surveillance, urban planning, and community collaboration is crucial. This study offers insights into sustainable dengue control policies, thereby enhancing urban resilience against outbreaks..

Keywords: *Dengue prevention, community attitudes, urban sustainability, public health, Sustainable Development Goal 11, Malaysia*

Introduction

The Growing Burden of Dengue in Malaysia

Dengue fever, transmitted by Aedes mosquitoes, has risen in Malaysia over the past few decades. Urbanisation has exacerbated dengue risks due to poor drainage systems, increased population density, and stagnant water accumulation, creating ideal breeding grounds for mosquitoes (Lee & Rohani, 2005; Bhatt et al., 2013). According to the Malaysian Ministry of Health, over 100,000 dengue cases were reported in 2020, resulting in more than 100 fatalities (IDengue Portal, 2020). The cyclical nature of dengue outbreaks underscores the complexity of controlling this disease, as factors such as extreme weather changes and community non-compliance impact prevention

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efforts (Vanlerberghe et al., 2009; Siwar et al., 2016). Various approaches have been explored, including Integrated Vector Management (IVM) and Sterile Insect Technique (SIT), yet gaps in knowledge dissemination and community adherence remain significant barriers (Ahmad Zamzuri et al., 2022; Dyck et al., 2005).

The Role of Community Engagement in Dengue Prevention

Eradicating dengue is not solely a government responsibility but requires active community participation (Caprara et al., 2015). Studies have shown that the collective behaviour of urban residents is pivotal in determining the success of prevention strategies (Selvarajoo et al., 2020). Knowledge, attitudes, and socio-demographic factors influence dengue prevention efforts, yet urban populations, despite their higher awareness, often face engagement gaps due to socioeconomic constraints (Guad et al., 2021; Mashudi et al., 2022). The disparity in community responses between urban and rural areas is also significant. In contrast, urban residents may be aware of preventive measures, but their social cohesion and collective action towards dengue prevention remain limited (Leong et al., 2019). Additionally, targeted health campaigns, such as fogging and public education, have effectively reduced mosquito breeding; however, their long-term sustainability requires more comprehensive policy integration (Andersson et al., 2015; Arham et al., 2023). Addressing these challenges requires an interdisciplinary approach that integrates community education, technology-driven monitoring, and strengthened governance mechanisms (Ali et al., 2021; Kazachinskaia et al., 2022).

Theoretical Framework

This study integrates behavioural theories with a systematic research approach to assess community attitudes and actions towards dengue prevention. The combination of theoretical models and scoping review methodology ensures that behavioural influences are systematically explored through empirical evidence.

- The Health Belief Model (HBM) examines how perceived severity, susceptibility, benefits, and barriers influence dengue preventive behaviour.
- The Theory of Planned Behaviour (TPB) considers the role of social norms and individual control over actions in determining dengue prevention practices.
- The Social Ecological Model (SEM) emphasises the interaction of individual, community, institutional, and policy-level factors in shaping dengue prevention efforts.

The research systematically examines factors influencing community attitudes by incorporating these theoretical models, offering an evidence-based foundation for improved dengue prevention policies. Additionally, this study aligns with the Sustainable Urban Health Framework, which supports Sustainable Development Goal 11 (SDG 11)—fostering sustainable cities and communities.

Methodology

Scoping reviews are a novel methodology for generating evidence, distinct from systematic reviews in their objectives. Grant and Booth describe them as preliminary evaluations of the breadth of existing research. Arksey and O'Malley's framework provides an overview of the literature without the strict criteria of systematic reviews, making it helpful in exploring broad questions and identifying research gaps (Gómez-Luna et al., 2014). They emphasise scoping

reviews for four main reasons: (1) to assess the scope of research on a topic; (2) to evaluate the advantages of comprehensive examination; (3) to synthesise findings across substantial evidence; and (4) to identify literature gaps for future research. For this review, 45 articles published between 2015 and 2023 were selected to study community attitudes towards dengue prevention, sourced from databases such as Google Scholar, PLOS, and PubMed.

Several inclusion criteria were used for selecting articles: they had to be published between 2015 and 2023, focus on behaviour, and specifically address community attitudes towards dengue prevention in Malaysia. The findings should explain the importance of community understanding and involvement in combating dengue. Excluded articles primarily did not meet these criteria, including those focused on foreign contexts or lacking a well-designed study format.

By aligning these criteria with the scoping review methodology, this study contextualises research findings within established behavioural models. It offers a comprehensive understanding of community engagement in dengue prevention, providing valuable insights for public health policy.

Results and Discussion

According to Table 1, the study on attitudes towards dengue prevention in Malaysian communities identified key research gaps, presenting opportunities to enhance the effectiveness of dengue prevention initiatives. Addressing these gaps will strengthen public health strategies for mitigating dengue outbreaks in Malaysia.

Table 1: Attitude Towards Dengue Prevention by Communities in Malaysia.

No.	Name of Author and Year of Publication	Research Title	Summarisation of the Research
1.	Arham et al. (2022)	"To do or not to do?"Determinants of stakeholders' acceptance of the dengue vaccine using PLS-SEM analysis in Malaysia.	Trust in key players shapes views on dengue vaccines. Positive perceptions enhance perceived benefits and risks. Religiosity affects attitudes and benefits, but its impact on perceived risks varies. In Klang Valley, stakeholders have a positive outlook on the vaccine and intend to get vaccinated, motivated by trust and perceived benefits.
2.	Ahmad Zamzuri et al. (2022)	Perceived risk for dengue infection mediates the relationship between attitude and practice for dengue prevention: a study in Seremban, Malaysia.	Perceived risk of infection impacts attitudes and actions regarding dengue prevention. When higher risk is sensed, positive attitudes lead to more preventive measures. Increasing health awareness and education can enhance dengue prevention through targeted messaging.
3.	Arham et al. (2023)	Fogging to combat dengue: factors influencing	This research analyses opinions on fogging for dengue control, focusing on benefits, risks, and influencing factors. Data will be collected

		stakeholders' attitudes in Malaysia.	through structured questionnaires administered to community members and health officials.
4.	Guad et al., (2021)	Development and validation of a structured survey questionnaire on knowledge, attitude, preventive practice, and treatment-seeking behaviour regarding dengue among the resident population of Sabah, Malaysia: an exploratory factor analysis.	The revised questionnaire is reliable for assessing knowledge, attitudes, and practices related to dengue treatment in Sabah. Eight attitude and eleven training items were retained based on KMO values, while low-scoring items were removed. It supports future public health strategies.
5.	Mashudi et al., (2022)	Level of dengue preventive practices and associated factors in a Malaysian residential area during the COVID-19 pandemic: A cross-sectional study.	The Health Belief Model (HBM) links dengue prevention to perceived severity and susceptibility. COVID-19 increased awareness of indoor risks, but reduced community efforts: education, past dengue experience, and access to information shape prevention. Higher education and experience improve behaviours. Targeted health education and community engagement are key, with HBM effectively predicting dengue prevention actions.
6.	Inriani et al. (2023)	Community participation factors in implementing dengue fever	The study found that the information source ($p = 0.027$) is the key factor in dengue prevention participation, while knowledge, attitude, and stakeholder roles were found to be insignificant. Clear education, regular check-ups, home visits, and promoting 3R practices (reduce, reuse, recycle) are crucial. An informed and engaged community is vital for dengue control.
7.	Selvarajoo et al. (2022)	Dengue surveillance using gravid oviposition sticky (GOS) trap and dengue non-structural 1 (NS1) antigen test in Malaysia: randomised controlled trial.	The study showed that combining GOS traps with NS1 antigen tests effectively enables early detection and control of dengue. This approach can enhance dengue surveillance and support public health efforts in areas affected by the disease.
8.	Saadatian-Elahi et al.	Measuring the effectiveness of	IVM strategies reduce dengue incidence more effectively than routine methods, offering a

	(2021)	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.	cost-effective and sustainable approach. The iDEM trial highlights IVM's potential in urban dengue control, advocating a shift to preventive public health policies.
9.	Leong et al. (2019)	Perceptions, attitudes, and responses to dengue early warning among the urban community in Kuala Lumpur.	Most participants found the dengue early warning system helpful, but were unaware of the impact of heat on outbreaks. Many wanted to learn how the weather predicts dengue. Older and more educated individuals were more likely to be active in prevention. While city residents mostly supported the system, some were less responsive. Better education can boost community involvement in dengue prevention.
10.	Siti Nur Farhana et al. (2022)	Development of assessment tool to measure children's knowledge on dengue prevention activities in Malaysia.	The tool reliably measures children's knowledge of dengue prevention, highlighting gaps that require targeted educational interventions. It supports targeted interventions to boost awareness among Malaysian schoolchildren.
11.	Ahmad Zaki & Xin (2022)	Dengue trend during the COVID-19 pandemic in Malaysia.	Dengue cases decreased during the COVID-19 pandemic, likely due to movement restrictions. Men and young adults (20-34) had the highest incidence. A negative correlation was observed between dengue and COVID-19 cases, except in individuals over 75 years old. This highlights the importance of integrated disease management during pandemics.
12.	Manaf et al. (2021)	A qualitative study of the governance	Participants emphasised the importance of accountability in governance, but faced challenges in holding public servants

		predicament in dengue prevention and control in Malaysia: The elite experience.	accountable. They raised concerns about the effectiveness of dengue prevention, bureaucratic hurdles, and poor stakeholder coordination. Views on healthcare staff were mixed, and inconsistent enforcement of regulations highlighted policy gaps.
13.	Rachmah Indawati et al. (2021)	The early vigilance of dengue hemorrhagic fever outbreak in the community.	The study found high community knowledge of DHF transmission and prevention (72.3%) but lower participation in preventive measures (67.7%). This gap between understanding and action highlights the need to enhance public awareness and surveillance for improved outbreak preparedness.
14.	Othman et al. (2019)	Applying health belief model for the assessment of community knowledge, attitude and prevention practices following a dengue epidemic in a township in Selangor, Malaysia	The population has a moderate understanding of dengue but follows preventive measures due to the perceived severity. Ongoing cases call for better education and engagement. Health programs should remove barriers, enhance perceived benefits, and boost self-efficacy. A holistic, HBM-based approach is needed for sustained prevention.
15.	Ain et al. (2017)	Knowledge, attitude and practice of dengue prevention among the sub-urban community in Sepang, Selangor.	The community has a positive attitude and awareness of dengue prevention, but struggles to implement it in practice. While many recognise mosquito breeding sites, prevention efforts, such as removing standing water, are moderate. Misconceptions persist, relying solely on fumigation. Educational campaigns are needed to turn knowledge into action.
16.	Said et al. (2018)	Dengue prevention practices among the community in the dengue hotspot area.	The study found high awareness of dengue but inconsistent prevention practices. Factors such as education, age, and socioeconomic status influence adoption. Enhancing community involvement, education, and resource allocation is key to improving prevention in hotspot areas.
17.	Abidemi & Aziz (2022)	Analysis of deterministic models for dengue disease transmission dynamics with vaccination perspective in Johor, Malaysia	The vaccine reduces dengue cases, but the most effective results are achieved by combining it with treatments and insecticides. Analysing dengue spread informs better prevention. A mixed approach to vaccination and insect control is essential for effective dengue management in Johor.

18.	Hamid et al. (2020)	Targeted outdoor residual spraying, autodissemination devices and their combination against Aedes mosquitoes: field implementation in a Malaysian urban setting.	The study found that TORS reduced the Aedes ovitrap index by 6.5% and ADD by 8.3%, with Ae. aegypti reductions of 10.4% (TORS) and 8.9% (ADD). However, combining both methods did not enhance effectiveness, highlighting the need for further research to optimise dengue control strategies.
19.	Halmi & Rahman (2020)	Comparative study of dengue prevention measures in Malaysian construction sites	Construction sites significantly contribute to dengue transmission by creating ideal conditions for mosquito breeding. Clusters near these sites face higher caseloads and outbreak risks. The study recommends stronger legislation, enforcement, and the adoption of Singapore's best practices to improve Malaysia's dengue prevention at construction sites.
20.	Mustafa et a. (2016)	Community awareness in dengue prevention among students in UNISEL Shah Alam student hostel.	Students have moderate awareness of dengue prevention but lack knowledge of key measures. Despite positive attitudes, prevention practices are inconsistent due to time and academic pressures. Targeted campaigns and ongoing education are needed to bridge knowledge gaps and encourage consistent prevention.
21.	Rao et al. (2016)	Predictors of practices related to dengue fever prevention among international students in Universiti Putra Malaysia, Serdang	Knowledge and attitudes play a key role in dengue prevention among international students. Awareness and positive attitudes increase participation in prevention activities; factors such as duration of stay and prior dengue exposure influence precautions. The study recommends targeted education and awareness programs in academic institutions to enhance students' knowledge and practices.
22.	Alhoot et al. (2017)	Knowledge, attitude, and practice towards dengue fever among patients in Hospital Taiping.	Patients have a moderate understanding of dengue and recognise symptoms and prevention, but hold misconceptions about transmission. While attitudes are strong, prevention practices vary, with some relying on government action. Enhanced education and community engagement are needed to strengthen prevention efforts.
23.	Chandren et al. (2015)	Practices of dengue fever prevention and the associated factors	The Orang Asli have moderate awareness of dengue but inconsistent prevention practices, mainly due to issues with education,

		among the orang asli in Peninsular Malaysia	healthcare access, and traditional beliefs. Community-based interventions, culturally sensitive health education, and targeted campaigns are necessary to enhance engagement. Targeted public health strategies are crucial for addressing the unique challenges in dengue prevention.
24.	Arfan et al. (2022)	Factors associated with dengue fever prevention practices in endemic areas.	Dengue prevention depends on awareness, but housing type, population density, and sanitation influence mosquito breeding. The Health Belief Model shows that perceived severity drives action. COVID-19 lockdowns increased mosquito activity, underscoring the need for indoor prevention measures. Targeted education and interventions are crucial for addressing knowledge and practical barriers in endemic areas.
25.	Rajapaksha et al. (2022)	Development of a complex intervention for dengue prevention	Researchers found that a COMBI strategy focused on behavioural objectives effectively prevents dengue by enhancing community participation, improving health services, and better waste management.
26.	Foucambert et al. (2022)	Efficacy of dengue vaccines in the prevention of severe dengue in children: a systematic review	A systematic review of dengue vaccines, including CYD-TDV (Dengvaxia), confirms its effectiveness in reducing the severity of dengue in children. However, serostatus, age, and serotype prevalence impact efficacy. Safety concerns persist for seronegative individuals, and variable effectiveness remains across serotypes. Further research is needed to improve global dengue immunisation strategies.
27.	Nyenke et al. (2023)	Dengue fever: aetiology, diagnosis, prevention and treatment.	Effective diagnosis and early detection of dengue, utilising clinical signs, PCR, and serology, are crucial for effective management. Prompt supportive care prevents severe cases. Prevention relies on mosquito surveillance, environmental management, community involvement, and vaccine development. Strengthening diagnostics, awareness, and collaboration is key to reducing dengue's global impact.
28.	Choudhary at al. (2022)	Dengue and natural remedies for its prevention and control: A review	Neem, papaya, and Andrographis paniculata may have antiviral and immunomodulatory effects against dengue. Traditional herbal remedies could strengthen immunity, but

			clinical evidence remains limited. Further research is needed to assess the effectiveness and safety of these measures, thereby supporting global dengue prevention efforts.
29.	Ghazali et al. (2022)	A conceptual design for COMBI dengue prevention based on integrated psychology and persuasive technology models	The multidisciplinary approach combines psychology with persuasive technology, beginning with a literature review to identify theories and models that promote healthy habits. Researchers developed a flexible conceptual framework for integrating these insights into dengue prevention strategies that are adaptable to different cultures and demographics, thereby enhancing their effectiveness.
30.	Waickman et al. (2022)	Biologics for dengue prevention: Up-to-date	Recent research advances biological dengue prevention through vaccines and monoclonal antibodies. Some vaccines protect against multiple virus types, while antibodies show promise for treatment and prevention. Challenges persist, including the diversity of viruses and their ability to evade the immune system. Combining treatments may enhance protection. This study highlights key efforts to reduce dengue's global impact.
31.	Kazachinskaia et al. (2022)	Problematic questions in the development of specific prevention of dengue fever	Four virus serotypes, insecticide-resistant mosquitoes, and socio-economic barriers challenge dengue prevention. Collaboration between scientists, healthcare professionals, and communities is essential for effective control strategies.
32.	Chng et al. (2022)	Knowledge, attitudes and practices of dengue prevention between dengue sustained hotspots and non-sustained hotspots in Singapore: A cross-sectional study	Residents in permanent hot areas are less knowledgeable and concerned about dengue than those in unsustainable hot regions, who engage more in prevention. Socio-economic status, community involvement, and education influence dengue transmission and control efforts.
33.	Kua (2022)	A multifactorial strategy for dengue prevention and control: A public health situation analysis	Dengue incidence analysis identifies high-risk areas and vulnerable groups influenced by water storage, urbanisation, and climate variability. Prevention efforts face challenges in terms of resources and engagement. Recommendations include strengthening healthcare, promoting cross-sector

			collaboration, and implementing sustainable community-based interventions.
34.	Rahman et al. (2022)	Scoping review: Barrier to the knowledge, attitude and practice on dengue prevention	The research highlights gaps in dengue awareness, misconceptions about prevention, economic barriers, and low community participation. Cultural beliefs also impact prevention efforts. Targeted education, community engagement, and supportive policies are essential for improving dengue control.
35.	Ali et al. (2021)	The effect of e-learning on the attitude toward dengue prevention and the acceptance of dengue vaccination	The e-learning intervention improved dengue prevention attitudes and vaccine acceptance, thereby enhancing knowledge and confidence in vaccine safety. The findings suggest that e-learning is an effective tool for public health education and community health improvement.
36.	Nasir et al. (2018)	Prevention of dengue virus infection	An integrated approach is most effective for dengue prevention, combining community cooperation, insecticide control, biocontrol strategies, and public health education. Careful use of insecticides prevents resistance, while the use of mosquito predators shows promise. Community involvement is crucial in reducing the risk of dengue.
37.	Makrufardi et al. (2021)	Factors associated with dengue prevention behaviour in riverbank area: A cross-sectional study.	Understanding dengue transmission is key to prevention. Eliminating standing water and using repellents can help reduce the risk. Wealthier families take more precautions, but poor waste and water management hinder efforts. Education and community involvement are crucial for effective dengue control.
38.	Wild et al. (2019)	Validation of educational booklet: an educational technology in dengue prevention.	The booklet scored 70%, indicating it is effective but needs improvement. Some content does not fully meet expectations and requires expert input. Despite this, it aids dengue prevention education. The study highlights the importance of high-quality educational materials in health campaigns.
39.	Md Taib & Atil (2023)	Tackling the dengue issue needs proactive measures: a narrative review of the current level of prevention	Dengue remains a significant issue in Malaysia despite mosquito control and education efforts. Challenges include poor case tracking and weak collaboration. The study suggests new tests and modified

		and control of dengue in Malaysia.	mosquitoes for better prevention. Governments, healthcare providers, and communities must collaborate to enhance dengue control.
40.	Liu et al. (2016).	Vaccines and immunization strategies for dengue prevention.	This research reviews dengue vaccines, including Dengvaxia, which are effective but unsafe for those without prior infection. Other vaccines show promise, but universal protection is needed. Booster shots may be required. Further studies are necessary to enhance safety and effectiveness.
41.	Bos et al. (2018)	Dengue: a growing threat requiring vaccine development for disease prevention	Dengue cases are rising globally due to urbanisation, climate change, and travel. Few vaccines have reached advanced trials. CYD-TDV (Dengvaxia) shows effectiveness but has safety concerns for seronegative individuals.
42.	Wong et al. (2022).	Dengue: a growing problem with new interventions.	Dengue is a global health issue driven by urbanisation, climate change, and travel. Dengvaxia and other vaccines are helpful, but their effectiveness varies. Mosquito control, community involvement, and the use of treated materials are crucial. Vaccination, education, global cooperation, and research are key to improving dengue prevention.
43.	Wong et al. (2015)	Factors affecting dengue prevention practices: Nationwide Survey of the Malaysian Public	The study found that education, access to information, and perceptions of mosquito control influence dengue prevention in Malaysia. Financial status and living conditions also affect prevention efforts. It recommends targeted health programs to improve awareness and attitudes, benefiting not only Malaysia but also those beyond its borders.
44.	Achee et al. (2015).	A critical assessment of vector control for dengue prevention	The study highlights the challenges in dengue mosquito control, noting that methods have both pros and cons and must be tailored to suit each community. It identifies gaps in knowledge and suggests exploring new approaches, such as behavioural therapy. Innovative strategies are crucial for reducing global dengue.
45.	Schiøler & McCarty (2016)	Vaccines for preventing dengue infection	Dengue vaccines vary in effectiveness across virus types. Ensuring safety in diverse regions is crucial. As the virus evolves, ongoing monitoring and updates are needed. Their

			study contributes to the development of better vaccines for dengue protection.

The findings of this study underscore significant gaps in community engagement concerning dengue prevention in Malaysia. Despite a high level of awareness, the implementation of preventive measures remains inconsistent among various socio-demographic groups. This section articulates how the results correlate with established behavioural theories—specifically, the Health Belief Model (HBM), Theory of Planned Behaviour (TPB), and Social Ecological Model (SEM)—and how they contribute to the overarching goals of Sustainable Development Goal 11: Sustainable Cities and Communities.

The Health Belief Model (HBM) elucidates health-related behaviour through several factors, including perceived severity, susceptibility, benefits, and barriers (Becker, 1974). Findings from this study indicate that while urban communities exhibit heightened awareness of dengue prevention strategies, their perceived susceptibility is often low, resulting in complacency regarding preventive behaviours (Guad et al., 2021; Leong et al., 2019). In contrast, rural areas demonstrate a higher perceived susceptibility due to frequent dengue outbreaks; however, structural barriers, such as inadequate waste management and limited access to healthcare, impede practical prevention efforts (Mashudi et al., 2022).

A significant barrier identified in dengue prevention is the heavy reliance on government-led interventions, such as fogging and vector control, rather than fostering proactive individual or community-driven prevention initiatives (Arham et al., 2023). Perceptions regarding the benefits of these prevention efforts vary; while some respondents view fogging as a vital solution, others perceive it as less effective than source reduction strategies (Ahmad Zamzuri et al., 2022). Addressing these perceptions requires targeted health communication strategies to increase perceived susceptibility and empower communities with a sense of self-efficacy regarding dengue prevention.

The Theory of Planned Behavior (TPB) asserts that behavioural intentions are influenced by attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). Findings from this study suggest that, although knowledge about dengue prevention is relatively high, actual engagement remains low due to the influence of social norms and perceived behavioural control. In urban communities, where social cohesion tends to be weaker, collective action against dengue is often limited, leading to preventive behaviours that are more individualistic than community-driven (Selvarajoo et al., 2020).

In contrast, rural communities often exhibit stronger social norms that support dengue prevention; however, they encounter logistical challenges, such as limited access to preventive resources (Chandran et al., 2015). The potential roles of community leaders, social influencers, and digital platforms in reinforcing positive norms around dengue prevention are currently underutilised. E-learning interventions have demonstrated promise in enhancing knowledge and vaccine acceptance, indicating that digital education strategies can improve perceived behavioural control in dengue prevention (Ali et al., 2021). To effectively leverage the TPB, public health strategies should focus on modifying social norms, promoting peer-led community initiatives, and providing digital tools that enhance self-efficacy in dengue prevention.

The Social Ecological Model (SEM) emphasises the interaction between individual, community, institutional, and policy-level factors in shaping health behaviour (McLeroy et al., 1988). The

findings align with SEM by demonstrating that dengue prevention is influenced by multi-level determinants, requiring an integrated approach.

At the individual level, education and risk perception influence dengue preventive actions (Ahmad Zaki & Xin, 2022). At the community level, social cohesion and collective engagement are significant in determining participation in preventive activities. Urban communities tend to exhibit lower levels of collective engagement, often due to weaker community networks and a reliance on top-down government efforts (Leong et al., 2019).

At the institutional level, governance, enforcement, and funding allocation gaps create challenges in sustaining long-term dengue prevention strategies (Manaf et al., 2021). Furthermore, technological solutions, such as mobile apps for reporting mosquito breeding sites, remain underutilised despite their potential for real-time community engagement (Kazachinskaia et al., 2022). Strengthening cross-sector collaborations between government agencies, private stakeholders, and community-based organisations can effectively address these multi-level barriers.

The findings of this study directly contribute to Sustainable Development Goal 11, which aims to create sustainable and resilient urban environments. Dengue prevention is a public health issue, as well as a socioeconomic and environmental challenge. Urbanisation, poor waste management, and inadequate drainage systems have exacerbated mosquito breeding, highlighting the urgent need for sustainable urban planning (Siwar et al., 2016).

Integrating dengue prevention into urban planning and governance is crucial from a policy perspective. This study suggests the need for:

1. Smart urban infrastructure that reduces mosquito breeding sites, such as improved drainage and sustainable waste disposal systems.
2. Community-driven waste management programs that empower local neighbourhoods to actively engage in dengue prevention.
3. Digital health monitoring systems that utilise AI-driven predictive modelling to anticipate dengue outbreaks and enhance targeted interventions (Kua, 2022).
4. Multi-sectoral partnerships among municipal authorities, public health agencies, and educational institutions to integrate dengue prevention strategies into city development plans.

By addressing individual, community, institutional, and environmental factors, policymakers can develop holistic interventions that reduce dengue transmission and contribute to more resilient and healthier urban spaces.

Conclusion

In conclusion, this study highlights the intricate interplay of individual behaviour, social norms, governance, and environmental factors in shaping dengue prevention strategies in Malaysia. By connecting the findings to the Health Belief Model (HBM), the Theory of Planned Behavior (TPB), and the Social Ecological Model (SEM), the research provides a comprehensive framework for understanding the barriers and facilitators in dengue prevention efforts.

Furthermore, the findings are consistent with Sustainable Development Goal 11, which

emphasises the importance of sustainable urban planning, effective health policies, and community-driven initiatives to foster healthier and more resilient urban environments. Future research should aim to integrate technological innovations and behavioural insights to develop more targeted and evidence-based strategies for dengue prevention.

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