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Evaluating factors in urban dengue prevention and control during Indonesia's COVID-19

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ABSTRACT

Amidst the COVID-19 pandemic, dengue hemorrhagic fever (DHF) persisted as a critical public health challenge in South Tangerang. This study employed a cross-sectional design and snowball sampling technique to evaluate the engagement of urban communities in dengue prevention, involving 234 participants. Findings indicate that while practices such as container emptying (76.5%) and water storage sealing (57.7%) were prevalent, activities like mosquito larvae inspection (36.3%) and breeding item disposal (34.6%) were less common. Alarmingly, personal protective measures, including mosquito net usage (11.1%) and repellent application (16.7%), were significantly lacking. Statistical analyses revealed notable correlations (p-value<0.05) between dengue prevention behaviours and factors, including beliefs, attitudes towards prevention, support from family and healthcare professionals, and knowledge about dengue prevention. The study highlights a critical disparity in dengue prevention efforts, showing a community bias towards environmental management over personal protection strategies. It calls for increased participation from families and healthcare professionals in dengue prevention initiatives and stresses the need for governmental interventions to improve training for healthcare workers. Ultimately, the study advocates for a comprehensive approach that merges environmental management with personal protective measures, urging governments to adopt integrated strategies for more effective dengue prevention.

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1. INTRODUCTION

Dengue hemorrhagic fever (DHF) represents a persistent and multifaceted public health challenge in Indonesia, attributable to the country's equatorial climate and unique archipelagic geography. These factors create favorable conditions for the *Aedes aegypti* mosquito, the primary vector for DHF, facilitating insect breeding. Since the inaugural dengue outbreaks in Jakarta and Surabaya in 1968, the Indonesian government has embarked on a robust and adaptive strategy to curb the impact of DHF [1]. Central to this strategy is the implementation of comprehensive vector control measures along with concerted efforts to enhance public health awareness. Identifying and eradicating mosquito breeding sites is critical, particularly in areas prone to mosquito proliferation [2]. This ongoing struggle against DHF is marked by a cycle of resilience, learning, and adaptation, underscoring the imperative for continuous innovation and strategic refinement to mitigate the burden of the disease on Indonesian communities [3].

In regions where dengue fever is endemic, the simultaneous presence of dengue virus and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) underscores the critical need for robust preventative strategies to curb the spread of both pathogens [4]. The rapid transmission of coronavirus disease 2019 (COVID-19), driven by SARS-CoV-2, is particularly notable in Latin America, a region with a history of numerous epidemics [5]. The clinical and laboratory profiles of dengue fever and COVID-19 exhibit pronounced similarities, including acute fever, myalgia, fatigue, and other influenza-like symptoms, in addition to thrombocytopenia and leukopenia [6]. These overlapping clinical presentations frequently lead to diagnostic inaccuracies, delays in treatment, and challenges in patient isolation [7], [8]. Owing to the symptomatic overlap, the confluence of dengue and COVID-19 in countries such as Indonesia notably intensifies the burden on healthcare systems [9]. Instances of misdiagnosis, exemplified by cases in Singapore where initial diagnoses of dengue were later revised to COVID-19, accentuate the intricacy of clinical manifestations and the risk inherent in false-positive dengue serological results [10]. Moreover, the considerable annual incidence rates of dengue in Indonesia, which the COVID-19 pandemic may further aggravate, highlight the complex challenges presented by these simultaneous health threats [11]. This complex scenario emphasises the need for an in-depth and systematic investigation to elucidate the multifaceted impacts and interrelations between these two prominent health concerns.

The dynamic and complex nature of the epidemiological trends of dengue fever in Indonesia is evident. Originally detected in metropolitan regions such as Jakarta and Surabaya, the disease follows a cyclical pattern, with a marked increase in cases every two years [12]. The rise in the vulnerability of the urban population is a direct consequence of several interlinked factors: swift urbanisation, lack of adequate infrastructure, and intensified effects of climate change. These factors collectively diminish the resilience of urban communities, making them more prone to various environmental, social, and economic challenges [13]. High population density areas with substandard environmental conditions and inadequate urban planning have become hotspots for the rapid propagation of the disease, thereby establishing themselves as centres of transmission and significant public health concerns [14], [15]. These pressing statistics highlight an immediate need for both thorough and effective preventive strategies, enhanced public health infrastructure, and a notable increase in community-focused educational and awareness initiatives. Such measures are crucial for significantly reducing the incidence of severe DHF outbreaks and mitigating their broad and varied impacts in the future.

In preventive measures, managing potential mosquito breeding sites by draining, covering, or recycling water-holding containers is pivotal, and the strategic use of mosquito nets and larvicides complements these efforts. A notable correlation has been observed between these preventive practices, community awareness regarding DHF, and the prevalence of *Aedes aegypti* larvae, collectively influencing disease incidence rates [16]. Despite these insights, significantly reducing the prevalence of DHF is fraught with challenges, chiefly due to the hurdles involved in educating communities and navigating complex urban landscapes characterised by high population density. Nonetheless, educational initiatives, particularly those targeting school students through tools such as posters and flipcharts, have shown promise in enhancing community awareness and fostering proactive engagement in preventive practices [17].

The importance of community leaders, including religious figures, local health professionals, and other influential personalities, in shaping public health outcomes has become increasingly evident, particularly in the context of DHF and COVID-19 [18]. Despite their potential to sway community behaviour and attitudes towards health initiatives, a notable gap exists in regions such as South Tangerang City. Health interventions, especially those targeting dengue fever prevention, are predominantly driven by health workers with minimal input from community leaders. This oversight may stem from leaders' limited experience in health matters or their general absence in health-related activities, which in turn diminishes their participation in health campaigns [19]. Therefore, addressing this gap is crucial. By leveraging the influence of community leaders, it is possible to enhance public engagement and adherence to health protocols, thereby fortifying collective efforts against dengue fever and COVID-19. This approach also becomes imperative as the latter exacerbates the health landscape, demanding efficient allocation of scarce medical resources and strict public health strategies.

To address this issue, strategies need to be recalibrated with a focus on empowering community leaders through targeted mentoring and extensive training programs [20]. Local health centres (*puskesmas*), should function as epicentres for such capacity-building efforts, transforming them into active hubs of education, collaboration, and community mobilisation. By tapping into, enhancing, and channelling the influence of community and religious leaders as well as health cadres, the resilience of communities against DHF, COVID-19, and other health adversities can be significantly strengthened. This strategy aligns with the broader objective of making health programs and policies more inclusive, participatory, and responsive to each community's specific dynamics and needs, enriching their implementation and ensuring their long-term viability and adaptability.

In the context of the Banten Province, the annual recurrence of DHF remains a persistent public health concern, as evidenced by consistent epidemiological data. For instance, in 2016, the province reported 5,087 dengue cases, corresponding to an incidence rate of 39.5 per 100,000 population, and witnessed the loss of sixty-five lives to the disease. A study at the Ciputat Timur Community Health Center in South Tangerang City further highlighted the continuing challenge of dengue fever, with 52 cases recorded from 2018 to June 2019 [21]. Despite over a decade of preventive efforts, the persistent prevalence of DHF highlights the need for in-depth reassessment and refinement of existing strategies. This study, conducted in 2020 amidst the complexities of the COVID-19 pandemic, was set against the urban backdrop of South Tangerang, Banten Province. It aims to dissect and understand the subtle nuances and interrelationships intrinsic to DHF prevention and community involvement, particularly in areas frequently besieged by epidemics. By doing so, this research provides a comprehensive roadmap for navigating the multifaceted terrain of DHF management, community mobilisation, and public health response during the concurrent challenges posed by the COVID-19 crisis.

2. METHOD

2.1. Study design and timeline

This study aimed to conduct an analytical investigation using a cross-sectional methodology. This research was conducted within the urban areas of South Tangerang City, which is situated in the province of Banten. Research activities were conducted between August and September 2020, coinciding with the peak impact of the COVID-19 pandemic. The timing of this event was carefully chosen to provide a comprehensive understanding of the numerous impacts and challenges that have surfaced during this critical phase of the health crisis. Emphasis was placed on meticulously analyzing data relevant to the urban setting to gain insightful observations of how the pandemic affected urban populations, healthcare systems, and public health initiatives within this geographical context. This study aimed to discover a nuanced understanding of the dynamics of the pandemic, which would allow for a detailed exploration of the strategies employed to mitigate its effects and the outcomes that result in public health and societal well-being in the urban centres of South Tangerang City.

2.2. Participants and data collection

The study employed an online questionnaire, accompanied by informed consent, distributed among participants recruited via snowball sampling, using referrals from family members or colleagues. This recruitment strategy resulted in the selection of 234 representative residents. To ensure inclusivity, particularly for elderly participants or those with limited capability to complete the questionnaire independently, the survey design allowed for assistance from family members or colleagues during the completion process. In this study, data collection was meticulously conducted by four enumerators trained in public health, to ensure the precision and dependability of the results. We ensured extensive and diverse participation by utilising a carefully crafted online questionnaire disseminated via Google Forms and facilitated by coordinators of health cadres (Jumantik) at the South Tangerang Community Health Center. Self-reported responses were marked by richness and depth.

2.3. Variables

The primary dependent variable was the engagement level of individuals in activities related to dengue fever prevention programs. Independent variables were categorised into several key dimensions: i) predisposing factors, which encompass the level of education, employment status, knowledge about DHF prevention, adherence to DHF preventive practices influenced by belief systems, commitment to the cleanliness of the house and surroundings influenced by religious beliefs, sleep patterns specifically during the hours–08:00-12:00 and 15:00-17:00, and general attitudes towards DHF prevention; ii) enabling factors, represented by the variety and reliability of information sources available to individuals, facilitate or hinder their participation in dengue prevention activities; iii) reinforcing factors include support received from family members, health cadres (Jumantik), health professionals, and community leaders in encouraging participation in dengue prevention efforts.

2.4. Sample size

It is noteworthy that data collection occurred during the COVID-19 pandemic in South Tangerang. Given the challenges and constraints posed by the pandemic, this study opted for a margin error (6.5%). This decision was made to accommodate sample size reduction, ensuring the feasibility and safety of the research process under the pandemic's extraordinary circumstances. Adjustment of the margin error reflects a

pragmatic approach to sample size determination, balancing the need for reliable data with logistical and health considerations during the pandemic period and the calculation of the minimum sample [22].

$$n = \frac{z^2 \rho(1-\rho)}{\in^2}$$

$n = The\ sample\ size;\ \epsilon^2 = The\ margin\ error$ (6.5%)
$\rho = Population\ proportion$ (0.5); $Z = 1.96$ (CI 95%)

$$= \frac{1.96^2 . 0.5\ (1-0.5)}{0.065}$$

=228 (our total sample was 234 Households)

To conduct the hypothesis test, we used the following formula: hypothesis test for sample size calculation to compare the two proportions [23].

$\alpha = 5\%;\ Power\ (1-\beta) = 80\%;\ P_1 = 0.40;\ P_2 = 0.60;\ Z\ alfa\ value = 1.96;\ Z\ beta\ value = 0.84$

$$n_1 = \left\{ z_{\ (1-\alpha/2)} + z_{\ (1-\beta)} \right\}^2 \frac{P_1(1-P_1) + P_2\ (1-\ P_2\ )}{\{P_1 - P_2\}^2}$$

$n_1 = 95$ and $n_2 = 95$

2.5. Potential bias

The use of online questionnaires and purposive sampling methods in this study poses potential biases, including self-selection and response bias due to voluntary participation and uncontrolled conditions during questionnaire completion. Despite efforts to mitigate these biases through random selection by data collectors, limitations in Internet access and participants' technological capabilities might still impact the representativeness and accuracy of the responses. To address the potential effects of these biases on research outcomes, this study employed data triangulation strategies through field observations conducted by several data collectors, thereby enhancing the validity of the findings and reducing the impact of potential biases.

2.6. Statistical analysis

The study gathered data on preventive behaviours, treated them as independent variables, and then classified them into two categories: effective and ineffective prevention programs, using the mean value as the division point. This grouping made it easier to use the Chi-squared test to examine the relationship between the dependent and independent variables. It also made it easier to determine the odds ratio (OR) with a 95% confidence interval (CI) to better understand the strength of these relationships and the way they go.

Descriptive statistics provided an overview of participants' demographics. Bivariate and subgroup analyses found links between the dependent variable and the factors that made it more likely to happen, more accessible for people to do something, or more likely to happen again. This methodological approach allowed for a concise yet comprehensive analysis of the factors influencing dengue prevention engagement among the South Tangerang population, contributing valuable insights for improving dengue prevention efforts and public health strategies.

Using Microsoft Excel, secondary data from all public health centres in South Tangerang from 2010 to 2027 were analysed to ascertain the region's status as a dengue endemic area. This detailed examination, facilitated by Excel's robust data analysis tools, sheds light on the prevalence and evolving trends of this disease. The findings serve as a foundation for developing targeted health interventions and shaping policy decisions to effectively mitigate the impact of this persistent public health issue.

2.7. Ethical approval

The Research Ethics Review Committee for Research Involving Human Research Participants of the Research Ethics Commission at the Faculty of Health Sciences, UIN Syarif Hidayatullah Jakarta, approved the study protocol after the entire board thoroughly reviewed it. It was approved by Un.01/F.10/KP.01.1/KE. SP/08.08.001/2020. All participants provided informed consent for this study after being informed about their participation and the possibility of follow-up in the future. To maintain confidentiality, participant data were anonymised, and consent was collected electronically. Additionally, participants were advised to contact the study team for therapy referrals or additional information, as well as for urgent care.

3. RESULTS AND DISCUSSION

3.1. The situation in South Tangerang

South Tangerang City, nestled within Banten Province, Indonesia, has experienced significant population growth, establishing itself as one of the nation's rapidly evolving urban regions. Covering about 147.19 square kilometers and comprising seven districts and 54 sub-districts; its population soared to 1,747,906 by 2019 [24]. This demographic expansion has bolstered the local economy and job market, yet it also brings forth challenges such as increased population density, demand for sufficient infrastructure, public services, and concerns over environmental sustainability.

The area has an average annual rainfall of 133.7 mm, indicative of a mainly wet climate, which has contributed to the endemic status of DHF in South Tangerang, with 424 reported cases in 2020 [24], [25]. Furthermore, the city has observed an increase in the number of people under monitoring (PUM) for COVID-19 from 308 to 336 individuals, and an increase in patients under surveillance (PUS) from 131 to 139 [26]. These developments highlight the critical role of comprehensive public health strategies and infrastructural advancements in tackling both the direct and indirect ramifications of swift urbanisation and climatic effects. Addressing these issues requires a holistic approach encompassing improved healthcare services, vector control initiatives, and public education to curb the spread of infectious diseases. Additionally, strategic urban planning is essential for sustainable development and for enhancing the overall well-being of the city's inhabitants.

Computer model predictions, with a 95% confidence interval, estimated that the endemic spread of dengue in South Tangerang could result in case numbers ranging between 303 and 1,273 by 2027. This forecast emphasises the urgent necessity for ongoing and comprehensive vector control practices, public health surveillance, and community involvement efforts to minimise the impact of dengue fever in the area. These data underscore the importance of adopting evidence-based strategies in health policy and urban development to effectively address the anticipated challenges in managing dengue transmission within this rapidly urbanising setting as illustrated in Figure 1 (The dataset on dengue fever in South Tangerang, gathered from *puskesmas* in 2020, was analysed using Microsoft Excel to forecast the endemic status of the area by 2027. This analysis aids in strategic health planning to combat dengue's ongoing impact).

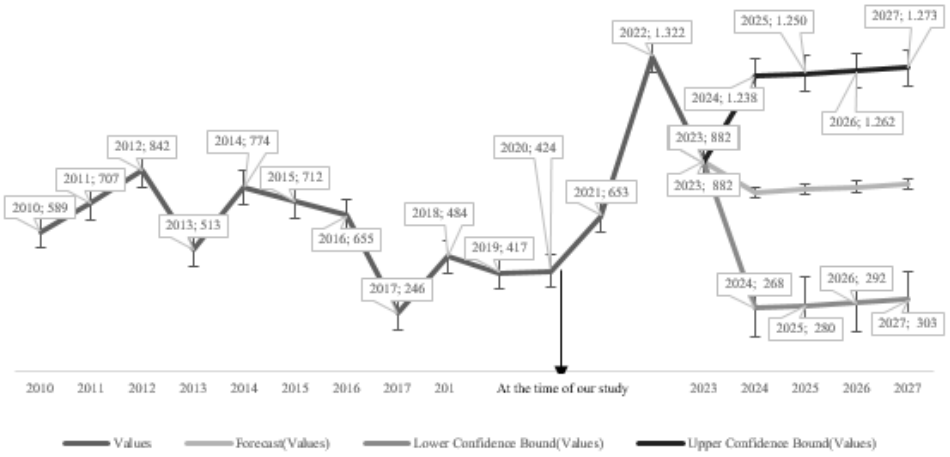

Figure 1. The illustration of cases of dengue fever in South Tangerang, starting from historical data from 2010 to predicted figures until 2027

3.2. Respondents' dengue preventive program activities

The study highlights the varied educational levels of participants: 9% had completed elementary school, 71% had received secondary education, and 20% had pursued higher education, with a notable 81% employment rate among respondents as detailed in Table 1. The preventive behaviours observed among the study population were mixed, with a substantial number of water-related measures, such as draining bathtubs (76.5%) and sealing water containers (57.7%). However, activities such as larval checking (36.3%) and the appropriate disposal of used items (34.6%) were less common. The use of personal protective methods, including mosquito nets (11.1%), repellents (16.7%), and insecticides (19.2%), was remarkably low. These practices highlight an urgent need to increase public awareness and implement stronger preventive strategies, as visually summarised in Figure 2 (The data source, derived from the primary data, was methodically organised and tabulated using Microsoft Excel), showcasing participants' participation in dengue prevention activities.

Table 1. The impact of predisposing factors on dengue prevention efforts

Characteristics	Dengue Prevention Programs							
	Not good		Good		Total			OR (95% CI)
	n	%	n	%	n	%		
Predisposing factors								
Level of education								
Primary school	12	5	10	4	22	9	0.57	1.343 (0.48-3.74)
Secondary school	92	39	73	31	165	71	0.47	1.278 (0.66-2.48)
Bachelor	29	12	18	8	47	20		Reference
Employment status							0.72	0.839 (0.44-1.61)
Do not have a job	24	10.3	21	9.0	45	19		
Have a job	109	46.6	80	34.2	189	81		
Knowledge related to DHF							0.02	
Not good	63	26.9	32	13.7	95	41		1.941 (1.13-3.33)
Good	70	29.9	69	29.5	139	59		
Preventive DHF behavior based on religious belief							1.00	
No	12	5.1	9	3.8	21	9		1.014 (0.41-2.51)
Yes	121	51.7	92	39.3	213	91		
Clean the house and surroundings based on religious belief							0.70	
No	5	2.1	2	0.9	7	3		1.934 (0.37-10.17)
Yes	128	54.7	99	42.3	227	97		
Practicing sleep deprivation at 08.00-12.00 and 15.00-17.00							0.01	
No	53	22.6	21	9.0	74	31.6		2.525 (1.40-4.57)
Yes	80	34.2	80	34.2	160	68.4		
Attitude							0.02	1.884 (1.11-3.22)
Not good	65	27.8	34	14.5	99	42		
Good	68	29.1	67	28.6	135	58		

Notes: The relationship between predisposing factors for dengue fever and its occurrence was assessed using the Chi-squared test. This method yielded a crude odds ratio, indicating the efficacy of the dengue prevention program.

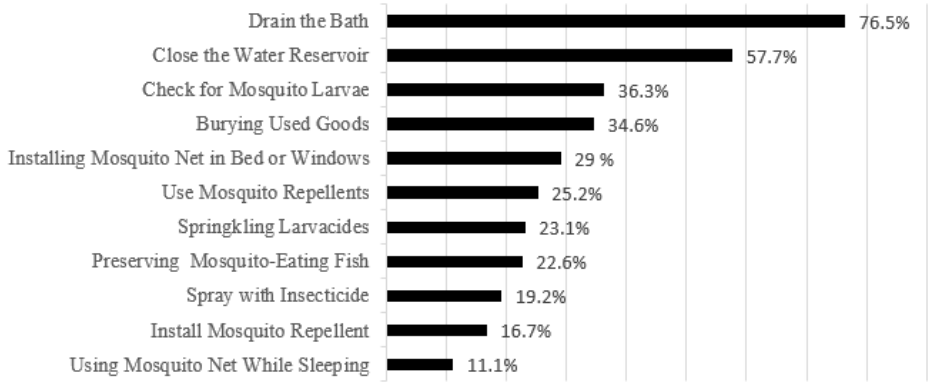

Figure 2. Respondents' dengue preventive program activities

The critical role of community involvement in enhancing the effectiveness of dengue prevention efforts has been well documented, particularly in disadvantaged urban areas [19]. Research advocates community support in primary healthcare initiatives, including dengue eradication efforts [27]. These dengue elimination strategies are primarily supported by community healthcare services, such as *puskesmas*, underscoring the importance of local health infrastructure in addressing dengue outbreaks [28].

Studies have consistently pointed out the challenges in dengue prevention and control efforts, identifying significant gaps in human resources, infrastructure, and financial backing [29]. A lack of skilled personnel hinders the implementation of comprehensive, timely, and appropriate responses. These gaps hinder routine operation and limit the ability to innovate and apply forward-thinking strategies in dengue management.

Government intervention is crucial for addressing the acute shortfall in dengue control resources [30]. Efforts should focus on increasing the workforce dedicated to this public health challenge by offering training programs aimed at enhancing skills, providing incentives to attract medical professionals to the dengue control field, and investing substantial funds in capacity-building infrastructure [31] [32]. These measures are vital to ensure an adequately sized health professional community is equipped with the necessary expertise and ability to engage and organise the community effectively. Implementing a

comprehensive, urgent strategy to strengthen the cadres of professionals committed to dengue control is imperative. Such targeted interventions are essential to equip health professionals with the necessary training, motivation, and skills to effectively navigate the complex challenges posed by the endemic nature of dengue, thereby improving the success of dengue control and prevention efforts.

The importance of involving communities in health initiatives, particularly for dengue eradication, is robustly supported by evidence [33]. This study uncovered a significant relationship between the effectiveness of dengue prevention programs and the active participation of health officers, as shown by a p-value of less than 0.05. The proactive and creative contributions of healthcare professionals are deemed essential, especially when communities are frequently left to deal with the ongoing pandemic with insufficient structured guidance from health authorities [34]. A noticeable disconnect exists in how health officers engage with community leaders, often seen as lacking the essential skills and expertise needed to conduct organised and systematic field interventions. This deficiency is evident not only during outbreaks, but also affects routine health practices.

The findings highlight an urgent need to improve the training and skills of health cadres, ensuring that they are adequately prepared to implement effective and organised preventive actions within communities. Enhancing collaboration and communication between health officials and community leaders is crucial for developing more efficient and long-lasting strategies for disease prevention and control. Proposed measures include establishing training programs aimed at health cadres, which would cover field intervention techniques, disease prevention strategies, and community engagement methods. By bridging these gaps, health authorities can cultivate a more empowered and informed community workforce that is ready to actively participate in dengue prevention efforts. Such advancements in health program effectiveness can significantly contribute to a decrease in dengue incidence rates, underscoring the pivotal role of skilled and engaged community participation in health initiatives.

3.3. Predisposing, enabling, and reinforcing factors

Table 1 showcases the significant correlations between various predisposing factors and the adoption of preventive behaviors against dengue. A key finding from this analysis is the substantial link between an individual's level of knowledge regarding dengue and their participation in prevention activities, as evidenced by a p-value of less than 0.05 and an OR ranging from 1.13 to 3.33 (p-value<0.05; OR=1.13-3.33). Notably, 49.6% of the surveyed individuals displayed a comprehensive understanding of dengue prevention measures, and this well-informed group was 1.94 times more likely to actively engage in dengue prevention and control initiatives.

Moreover, the study highlighted the importance of awareness concerning the risks of exposure during peak mosquito activity hours (08:00-12:00 and 15:00-17:00). Participants who were cognizant of these risks were 2.5 times more inclined to adopt preventive measures, with an OR between 1.39 and 4.56 (p-value<0.05; OR=1.39-4.56). This finding underscores the critical role of temporal awareness in enhancing the effectiveness of individual- and community-level dengue prevention efforts. Additionally, attitudinal factors emerged as significant, illustrating the intricate relationship between attitudes and the implementation of preventive behaviours in the fight against dengue. This aspect points to the complex interaction of knowledge, attitudes, and practices (KAP) in determining the likelihood of individuals engaging in actions that mitigate the risk of dengue transmission.

These insights underline the necessity of multifaceted approaches to public health campaigns aimed at dengue prevention. Educational programs that not only increase knowledge about dengue and its vectors, but also address attitudinal shifts toward proactive prevention measures are crucial. By fostering a comprehensive understanding of and favourable attitudes toward prevention, individuals and communities can significantly contribute to reducing the incidence of dengue, highlighting the power of informed and engaged populations in combating this public health challenge.

The essential interplay between understanding and actions in combating dengue underscores the critical role of informed decision-making and behavioural changes in dengue prevention efforts [35]. Education and awareness-raising initiatives are key to fostering an understanding that translates into active community involvement in dengue control [36]. The combination of knowledgeable awareness and practical measures is fundamental to reducing dengue spread and managing outbreaks, highlighting the need for ongoing educational and engagement programs tailored to different community contexts.

A sophisticated, comprehensive strategy incorporating education, infrastructure improvements, enabling policies, and strong community engagement is vital for addressing the threat [37]. Educational efforts should extend beyond awareness to equip communities with preemptive tools and knowledge [37]. Preventive measures need to be integrated with educational campaigns for practical application [38], while policies should support prevention as a standard practice [39], positioning communities as proactive participants in dengue prevention. Health professionals play a crucial role in community-level dengue

prevention, extending beyond medical services to include mentorship and education for community leaders, local cadres, and the general populace [40]. Integrating these educational efforts with the frameworks of *puskesmas* enhances the effectiveness of dengue prevention strategies [28].

Table 2 indicate that family support as the reinforcing factors has significant relationship in enhancing dengue prevention program (p-value 0.05 with OR 7.259). Moreover, support from health officer is also important to improve the program (p-value 0.01 with OR 2.649). Family support significantly influences adherence to dengue prevention measures, with family backed individuals being more likely to follow protocols [41]. This emphasises the family's strategic role in reinforcing public health initiatives and highlights the importance of collaboration between health professionals and families for disease eradication efforts at the community level. The COVID-19 pandemic presents a strategic opportunity for health professionals to stress the importance of personal and family health practices in maintaining overall well-being and preventing disease transmission [42]. The heightened public health awareness during the pandemic creates an ideal backdrop for health education initiatives, which are crucial for fostering preventive health behaviours [43].

However, a notable shortfall in community leader engagement within DHF prevention programs has been identified [37], [39], [44]. This gap has become more pressing during the pandemic, emphasising the need for strategic inclusion of community leaders in DHF prevention and management. Their influence and access can significantly contribute to educating, motivating, and mobilising community participation in effective DHF prevention practices [39], [44]. This study also underscores the significant impact of societal attitudes and beliefs on health behaviour, which can be influenced by education and training [45]. Preventive programs are deemed the best solution for dengue eradication, with prevention behaviour crucial for reducing DHF cases [45]. This necessitates consistent preventive actions among community members, along with adherence to COVID-19 protocols, to fortify the community's defense against health challenges, demonstrating the importance of a cohesive and informed community in establishing a robust system of prevention and protection.

Table 2. The role of enabling and reinforcing factors in enhancing dengue prevention programs

Characteristics	Dengue prevention programs						p-value	OR (95% CI)
	Not good		Good		Total			
	n	%	n	%	n	%		
Enabling factors								
Availability of DHF information sources							1.00	1.132 (0.431-2.975)
No	6	2.6	40	17.1	46	20		
Yes	22	9.4	166	70.9	188	80		
Reinforcing factors								
Family support							0.05	7.259 (0.91-58.26)
No	9	3.8	1	0.4	10	4		
Yes	124	53.0	100	42.7	224	96		
Cadre support							0.12	2.004 (0.91-4.41)
No	24	10.3	10	4.3	34	15		
Yes	109	46.6	91	38.9	200	85		
Health officer support							0.01	2.649 (1.30-5.42)
No	35	15.0	12	5.1	47	20		
Yes	98	41.9	89	38.0	187	80		
Community leader support							0.33	1.306 (0.76-2.24)
No	53	22.6	34	14.5	87	37.2		
Yes	80	34.2	67	28.6	147	62.8		

Notes: The correlation between enabling and reinforcing factors for dengue fever incidence was evaluated using the Chi-squared test. This approach generated a crude OR and measured the effectiveness of the dengue prevention program.

4. CONCLUSION

This study highlights key facets of dengue prevention, underscoring the importance of community involvement and the need for improved public awareness of preventive practices such as larval inspection and waste disposal. This highlights the significant role of *puskesmas* in healthcare and the challenges faced owing to limited resources and personnel. The findings advocate for government intervention to enhance dengue control health cadres through focused training and incentives, aiming to bolster the effectiveness of dengue prevention and control strategies.

This research further highlights the paramount role of health professionals, family support, and the strategic use of the COVID-19 pandemic period for health education. Health professionals are not just service providers, but key figures in mentoring and organising community-based dengue prevention programs, ensuring a comprehensive approach to the issue. Family support is a strong influencer of preventive behaviour, with a significant correlation between family involvement and the effectiveness of prevention

programs. The COVID-19 pandemic is an opportune moment for health education, emphasising the importance of personal and family health in preventing disease transmission. Nevertheless, the study identifies a gap in the engagement of community leaders in DHF prevention programs, indicating the need for active participation and leadership in education and mobilisation efforts. This study underlines the complex interplay of education, community engagement, and initiative-taking health measures in forming a robust defense against dengue, necessitating a cohesive and informed approach to establish a solid foundation for prevention and protection.

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